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UNIVERSITY OF ALBERTA

I AM THE TEACHING:
A STUDY OF TWO BIOLOGY TEACHERS' FUNCTIONAL PARADIGMS

by

CHERYLE MARGARET KACHMAN



A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF SECONDARY EDUCATION

EDMONTON, ALBERTA

FALL, 1991



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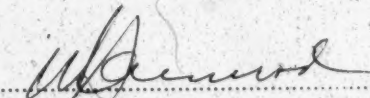
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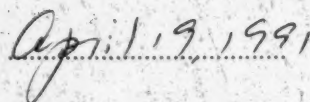
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled I AM THE TEACHING: A STUDY OF TWO BIOLOGY TEACHERS' FUNCTIONAL PARADIGMS submitted by CHERYLE MARGARET KACHMAN in partial fulfillment of the requirement for the degree of MASTER OF EDUCATION in SECONDARY EDUCATION.


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April 19, 1991

ABSTRACT

This research is an examination of elements of two teachers' functional paradigms as guided by the following questions:

1. What are the elements in the functional paradigms of two senior high school biology teachers as inferred from the teacher's own statements?
2. To what extent are the elements of these teacher's functional paradigms present in classroom activity and discourse?
3. What values and/or world views influence these biology teachers' interpretation of classroom function?
4. What is the relationship between espoused teacher views of classroom function and of observed classroom function of that teacher?
5. How are the elements of the functional paradigm established and communicated to students within the classroom setting?

The methodological approach to this study followed the naturalistic or qualitative paradigm. In order to gain some insight into what teachers do in the classroom and why, a case study approach was deemed to be most appropriate. The data were collected by conducting four formal interviews with each teacher, audio-taping in excess of eleven consecutive classes (a total of 55 periods) at two levels with each participant, and writing field notes of observations during classroom interaction. In addition, each teacher was observed and audio-taped during the introductory classes at the beginning of the semester. Instructional materials such as handouts, examinations, course outlines and other curricular materials were collected. An interview with each of the principals was conducted for the purpose of gathering data about the school milieu.

As a result of the interpretation of the data, the researcher inferred the following conclusions:

1. Functional paradigms exist and can be described in ways that reveal how teachers function in the classroom.
2. Common elements are present but different emphases are given to the elements of the functional paradigm by each teacher participant giving the appearance of different paradigms.
3. Varying degrees of consistency were discovered between the espoused statements about classroom functioning and observed classroom functioning.
4. Functional paradigms appear to be based on factors that go beyond the curriculum of the day.
5. The elements of the functional paradigm are present and are actively communicated to students during instructional sequences.

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I am very much indebted for the tremendous support and encouragement that I received from my professors. This research project would not have been possible without the backing of my supervisor, Dr. Wallie Samiroden, who was also understanding and provided much needed guidance. As well the encouragement, constructive comments and scholarly advice offered by Dr. Heidi Kass were invaluable. I very much admire her academic integrity. Dr. Pat Rowell's insights and suggestions were very much appreciated.

I am greatly indebted to the two teachers in my study who allowed me to enter their professional lives, gave willingly of their time and shared themselves with me. From you, I vicariously learned a great deal about myself.

I am also very thankful to my family, Ron, Olivia and David for their continued understanding and cheering of my efforts, and especially to Ron who was instrumental in the final writing stages of this project. To my sister, Toni, who passed away during the execution of this work, I dedicate this effort. Your inspiration will forever be a part of me. Thank you.

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1

CHAPTER I

THE PROBLEM

Introduction

During my tenure as a teacher of biological science at the high school level, I have utilized some innovative student-centred teaching strategies as well as some traditional teacher-centred techniques. I have not always balanced the use of these strategies. For example, for a period of approximately 10 years I was involved in an individualized continuous progress program which involved students progressing at their own rate through Biology 10, 20 and 30; which are mainstream courses, that incorporate topics that are similar to other countries (Alberta Education, 1978). Central to this concept was a team-teaching approach where two teachers together coordinated and taught a group of 60 to 70 students. Many questions arose for me from this experience including:

Why were we amenable to this approach?

Why were other teachers not attracted to these strategies?

Why were we able to continue in our endeavours for 10 years whereas other innovations tend to fade much more quickly?

What was different about the teachers that were involved in this project?

How were new teaching members persuaded to continue in the same vein?

Why did the biology experiment continue whereas the chemistry and

physics modes took different directions?

Why did the teachers leave the school after the last vestiges of the program were eliminated?

Why did I personally revert, for a time, to a very teacher-centred approach after experiencing the individualized continuous progress program?

Why have I subsequently attempted to re-establish a balance in the the types of strategies and the type of classroom that I facilitate?

Reflection on these questions and the idea of establishing a research project that attempts to find some explanatory principles for these behaviours was an exciting challenge.

During my period of teaching biology I had experienced some curriculum changes. For example, the biology curriculum of about 1968 incorporated student projects as a requisite aspect of the courses. Great opposition was expressed by some Alberta biology teachers toward this strategy and eventually in the curriculum of 1984, the inclusion of student projects became an optional teaching strategy for the program. Inclusion of student projects was quickly embraced and very fruitful. Why did I (and others) choose to adopt this curriculum aspect easily and quickly whereas other teachers of biology refused to do so? On the other hand, why do I (and likely others) feel an inner tension and resistance to using interactive debating as a teaching strategy? Why do teachers feel these resistances? Why do teachers oppose curriculum changes?

Theoretical Framework to the Study

Work in Britain (Driver, Guesne, and Tiberghien, 1985), New Zealand (Osborne and Freyberg, 1985), Australia (Brumby, 1984; Fensham, 1984), United States (Posner, Strike, Hewson, and Gertzog, 1982), and in Canada (Erickson, 1979; Kass, 1990) has focussed on alternative conceptions (naturalistic tendencies) in students. This work has explored the phenomenon whereby students come to school with nonscientific explanations for natural events and the tenacious resistance that is exhibited by the students in accepting the scientific explanations. The student's resistance in accepting a different explanation seems to parallel some teacher's resistance to accepting curricular change. The suggestion is that the milieu composed of the teacher's personal and academic background, the teaching environment, personal beliefs, values and experience constitute the practical knowledge which the teacher uses to ply his or her craft. Several researchers (Clandinin, 1986; Connelly and Elbaz, 1980; Crocker, 1983; Elbaz, 1983; Imershein, 1977; Schon, 1983) have focussed their attention on the tacit practical knowledge of professionals in relation to the well-established explicit bodies of knowledge and techniques that professionals utilize. Schon (1983) defines practical knowledge in the following way:

When we go about the spontaneous, intuitive performance of the actions of everyday life, we show ourselves to be knowledgeable in a special way. Often we cannot say what it is that we know. When we try to describe it we find ourselves at a loss, or we produce descriptions that are obviously inappropriate. Our knowing is ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing. It seems right to say that our knowing is *in* our action. Similarly, the workaday life of the professional depends on tacit knowing-in-action. (p. 49)

In Kuhn's (1970) analysis of scientific practice, he points out that a science

student does not learn a set of rules or theories which he applies in research, as was commonly thought, instead, the student is introduced to a common set of examples, the operation of specified instruments and a set of common research questions which are provided by the current paradigm. Scientific practice is learned by relying upon and using examples of scientific research. The idea of a paradigm as described in Kuhn's influential book, *The Structure of Scientific Revolutions* incorporates the constellation of assumptions, beliefs, values, techniques, exemplars, and routines shared by a community of scientists and used by this community of scholars to solve puzzles in what Kuhn terms "normal science". According to Kuhn, scientists use familiar principles to solve new scientific problems. When this form of problem-solving breaks down, that is, familiar examples are no longer adequate to solve the new problems arising, pressure is exerted to reconsider the paradigm. Kuhn called this "revolutionary science". When a new paradigm is in place, scientists look at phenomena with a different set of perspectives.

Imershien (1977) extended Kuhn's arguments by considering the organization of health care activities as similar to scientific activities and applying to the health field the idea that science students learn to be scientists by not only learning the rules of the profession but also by using the rules and carefully following outlined examples.

Assuming that teachers are similar to other communities of practitioners in that they share common goals, exemplars, routines, and problems, Crocker (1983) used the term "functional paradigm" to denote the shared characteristics which unite a community of teachers and are centred on practical aspects of teaching. Thus by identifying the factors that are considered important by teachers for the smooth functioning of a classroom, teacher behaviour can be illuminated. Teachers working

within a paradigm offer an exemplar for new colleagues and thus perpetuate the paradigm. It is only when overwhelming problems become evident and solutions within an alternative paradigm are present that change is likely to occur.

The current study undertakes to determine some of the characteristics, that is, some of the beliefs, values, techniques, routines, and exemplars of the functional paradigm of two teachers. The study endeavours to elucidate the functional paradigm by interviewing two selected teachers and observing their classroom behaviour.

Statement of the Problem

This study is an indepth examination of some of the characteristics that compose the functional paradigm of two senior secondary school biology teachers and how these characteristics affect the interpretation and implementation of biology curriculum into classroom practice for these teachers. The context of the study is two senior high schools in Alberta, Canada, in 1987 with the present biology curriculum (revised 1984) providing the content outline. The focus of the study is on the teacher and his or her implementation of curriculum and not on the evaluation of the teacher and/or the curriculum.

Guiding Questions

The research project, consisting of two case studies, is guided by the following five broad questions:

1. What are the elements in the functional paradigms of two senior high school biology teachers as inferred from the teachers' own statements?
2. To what extent are the elements of these teacher's functional paradigms present in classroom activity and discourse?
3. What values and/or world views influence these biology teacher's interpretation of classroom function?
4. What is the relationship between espoused teacher views of classroom function and of observed classroom function of that teacher?
5. How are these elements of the functional paradigm established and communicated to students within the classroom setting?

Using a case study approach, interviews with participant teachers will attempt to derive the characteristics of each teacher's functional paradigm as well as the teacher's world views which influence how the teacher interpretes curriculum into classroom function. Classroom observation and audio-taped lesson transcripts will be used to discern the extent to which these characteristics are present in classroom activity and discourse. Observation of introductory classes will be used to determine how characteristics of the functional paradigm are established and communicated to the students. Analysis of teacher interviews and comparison to taped classroom interaction should help to derive the relationship between espoused teacher views and observations of the classroom.

Definition of Terms

classroom practice - all of the teaching activities employed by the teacher including the selection and/or development and use of materials, notes, experiments, laboratory

exercises, demonstrations, field trips, projects, guest speakers, films, etc.; presentation of course content and evaluation of student achievement.

functional paradigm - the constellation of beliefs, values, methods, routines, and exemplars that guides a teacher in his/her everyday practice. (After Kuhn, 1970; Imershien, 1977; and Crocker, 1983)

novel teaching strategy - a methodology that was previously not a part of a particular teacher's repertoire of methods and routines.

paradigm - a term employed by Kuhn (1970) to designate the shared constellation of beliefs, values, methods, routines, exemplars, and scholarly knowledge that guides the work of a scientist in a particular scientific community.

paradigm shift - the change from one paradigm with its associated framework to an alternative paradigm with a different set of beliefs, values, methods, routines, exemplars and knowledge.

practical knowledge - set of practically-oriented understandings which teachers use to actively shape and direct the work of teaching (After Elbaz, 1983).

implementation - the act of translating a curriculum as outlined by curriculum developers into classroom practice by teachers.

interpretation - the process of explaining the structure of a curriculum in light of personal belief, value and knowledge.

senior secondary biology teacher/high school biology teacher - a teacher who is primarily involved in teaching Biology 10, 20 and/or 30 at the senior high school level.

Design of the Study

This is a qualitative examination of the characteristics of the functional paradigm of two senior high school biology teachers. Field notes completed during the classroom observations were used in a situational recall manner to stimulate interview dialogue and clarify elements of each teacher's functional paradigm. The extent that elements of the functional paradigm are actually present in classroom activity and discourse will be ascertained by keeping a journal of field notes as well as by audio-taping classroom activities. The relationship between the espoused teacher views and classroom action as observed in the audio-tapes will be established. Field observations and audio-taping of classroom interaction during the first day of classes will be utilized to gain insight as to how characteristics of the functional paradigm are established and communicated to the students within the setting of the classroom, that is, how the teacher sets the classroom tone and outlines the expectations for the year's work. Teacher handouts, examinations, school documents, and interviews with the school principals for the purpose of collecting background information about each school will supplement the data.

The case study format was inspired by the qualitative aspects of the work completed by Lantz (1984) entitled *The Role of Chemistry Teachers' Functional Paradigms in Translating Curriculum Materials into Classroom Practice*. In his study, Lantz examined the interpretive process used by senior high school chemistry teachers in translating a specific set of curriculum materials called *ALCHEM* into classroom practice. Qualitative data were collected from classroom observations and interviews with three chemistry teachers in an atmosphere of two chemistry teachers "talking shop". An adaptation of Schwab's (1973) four curriculum commonplaces were adapted

to organize the data. This was envisioned to be an appropriate working framework for this study as well.

Criteria for selecting the participants included the fact that they were respected colleagues of the researcher, that they were committed professionals and that they were able to articulate their points of view and were interested in doing so. In any case study it is necessary to establish a good rapport between the researcher and the participants and it was deemed that establishment of this rapport would be easy because the researcher knew and admired the efforts of both participants. Also a relationship that involves equality, caring and some feelings of "connectedness" is seen as a positive factor contributing to a more complete revelation of the participants' functional paradigm. Since interview data forms a vital component in these case studies, it was important that the participants be articulate and be willing to devote the necessary time to discuss their views. The selected participants were located in two urban high schools represented by two school jurisdictions (Edmonton Public Schools and Edmonton Catholic Schools). Although this proved more difficult for the researcher, it may prove to be advantageous to the gathering of data in that the participating teachers would not confound the data through discussions among themselves.

Delimitations

To make the research project manageable the following delimitations serve to focus the work:

1. Only two participants were selected for study. Since the research was an

examination of the elements that comprise the functional paradigm of a teacher—and how these elements interact in the individual's professional life, it is important to examine the participants in detail. Therefore selection of only two participants facilitates study of each in some depth.

2. The curriculum is delimited to the biology program outlined in the document *Program of Studies for Senior High Schools* (Alberta Education, 1978) and the observation and discussion of classroom practice is delimited to senior high school biology classes. Since the researcher is also a high school biology teacher, it was deemed that the most relevant information could be gleaned from professionals who taught and understood the same subject matter. The teachers' approach to leading extracurricular activities was not examined except in how it touched the biology classroom practices.

3. Observation was delimited to two consecutive biology classes per participant. This allowed the researcher to observe teaching at two different levels with each teacher and afforded an opportunity to check the consistency of the elements observed in the functional paradigm with students at two grade levels.

4. Observation of each of the classes with each participant was delimited to observing the teaching of one complete topic area from beginning to end as signified by the administration of a unit examination. As well each teacher was observed during the first day of the school year to observe the manner in which the courses were introduced and how the teacher set the tone for the subsequent work in that class. Because of the range of topics that were observed, there were no delimitations on subject matter.

5. Classroom observations and interviews are delimited to gathering data about

elements that contribute to teachers' working environments and classroom practices. This data consisted of four interviews with each teacher, the writing of field notes about each of the observed classes and the audio-taping of each of the classes visited. The field note data and classroom observations were used to formulate some of the questions used to stimulate dialogue during the interviews.

Limitations

This research project was limited by several factors:

1. The brief time span of approximately two and one-half months that was spent with the participants was a limitation that was imposed on the study.
2. Prior professional contact between the researcher and the participants may influence the verbal responses elicited during the interview process.
3. The two case studies capture an instant in time and space which is held against a moving changing reality. The case studies are a representation of two teacher functional paradigms during that time only.

Assumptions

It is assumed that if individuals are to be able to describe the characteristics of a complex social situation such as the classroom, they must be able to see the interactions among the characteristics that occur. That is, it is assumed that perceptions about the teacher's functional paradigm and its subsequent effect can be deduced through interviews, classroom observation and audio-tapings of classroom activity. It is assumed that the researcher will be able to discern what is significant in the observations. In this sense, seeing is regarded as an achievement that is cognitive in nature; it is not simply a task to be performed. It is also assumed that interview dialogue will express honest real feelings rather than those that may throw a "positive light" upon the person being interviewed. It is assumed that the teacher's functional paradigm governs implementation of curriculum generally as well as novel teaching strategies, and curricular innovations. It is also assumed that the description of the functional paradigm of teachers of senior secondary biological science will help some persons or groups to better understand the situation being described than they would without the benefit of the description. The interpretations of the collected data about each of the participants serves to provide a snapshot photograph of the participants during that period in their professional lives. It is assumed that during my short stay in the classrooms of the selected teachers that change in their functional paradigms was absent or minimal.

Ethical Considerations

The welfare of the teacher participants in this study is of vital consideration to the researcher. The teachers participating in this research project have agreed to do so on a voluntary basis. Each person was aware that he or she may withdraw from the study at any time without explanation. Pseudonyms were chosen together with the participants to help ensure anonymity as far as possible. Permission to work with the selected teachers was solicited from the respective principals. Permission to enter the specific schools in which these teachers work was requested from the central offices of Edmonton Public Schools and the Edmonton Catholic School Board by submission of the Cooperative Activities Program Research Application Form. Parents of the students whose lessons were taped were informed of the nature of the research and the students had the option of not participating in the audio-taped lessons.

Timeline for Data Collection

The collection of the data proceeded in two phases: observation, audio-taping and interviewing Catherine in her school and then proceeding to do the same with Tom in his school. Table 1 presents the timeline outlining aspects of data collection.

Table 1

Timeline of Data Collection

Time	Data Collection
September 8, 1987	Observed, wrote field notes and audio-taped Catherine's first meeting with her Biology 10X and Biology 30 students
September 9, 1987	Observed, wrote field notes and audio-taped Tom's first meeting with his Biology 20 and Biology 30 students
September 10-October 15	Observed, wrote field notes and audio-taped 15 consecutive Biology 10X classes including an all-day field trip on October 6, 1987 and 16 consecutive Biology 30 classes. Audio-taping did not occur during the field trip, the showing of films/slide tape presentations and the writing of quizzes/unit examinations.
September 16, 23	Interviews with Catherine
October 2, 15.	Interviews with Catherine
September 17	Interview with Catherine's school principal
October 20 - November 25	Observed, wrote field notes and audio-taped 11 consecutive Biology 20 classes including one which was an interactive debate and 13 Biology 30 classes. Audio-taped classroom activities on each of the days except during quizzes and unit examinations.
October 21	Interview with Tom
November 4, 16, 17	Interviews with Tom
October 26	Interview with Tom's school principal

Significance of the Study

This research project is significant in that it will contribute to the research directed at understanding what constitutes functional paradigms and the reasons for various kinds of activities exemplified by teachers. Additionally the study of elements of functional paradigms is significant in that the examination of the elements that comprise functional paradigms has the potential of explaining why a teacher behaves in a certain manner and thus may be applied as a methodology to better understand myself and the effectiveness of my own classroom function. It has the potential of helping me understand my own resistance to certain kinds of changes. This study can be significant in that it can be a personal contribution to the participants' understanding of why they do what they do and one which may enable the participating individuals to realize more fully their potentialities within their particular situations.

The Organization of the Thesis

The thesis consists of five chapters and three appendices which are organized in the following way:

Chapter I outlines the personal ground of the author as well as the design and theoretical framework of the study. The research problem is stated and the guiding questions for the research are given. Terms important in this study are defined and the significance of the study is indicated.

In the second chapter, a review of the literature relevant to this research project is presented.

The design of the study is presented in the third chapter. The data collection techniques are described including participant selection for the case studies and the various types of teacher observations consisting of taped interviews and subsequent transcripts, field notes and audio-tapings of classroom activity. As well, the procedures used to analyze the collected data are outlined.

Chapter IV presents and discusses the data of the thesis research. The findings for both case studies from the teacher observations are reported and discussed.

A summary of the findings from this research work are presented in Chapter V. The data collection methodology and analysis procedures are reviewed and the guiding questions are used to consolidate the results. The major findings of the research project are presented and recommendations for further research in the area are indicated.

The appendices contain background information. Appendix A contains a letter used to gain permission from parents to audio-tape students, a questionnaire used to gather information about the personal and academic history of the participants, an observation sheet used to gather information about the classroom setting, and a set of interview questions used to gather data about the school from the principals. Appendix B contains an outline of pre-prepared interview questions for discussion with Catherine as well as the transcriptions of the interviews whereas Appendix C contains similar questions prepared for discussions with Tom and the transcriptions of Tom's interviews.

CHAPTER II

SURVEY OF SELECTED LITERATURE

Introduction

The literature reviewed in this chapter is divided into two sections: background to the study and background on the process of teaching.

Background to the Study

During a regular school day, teachers frequently are required to act quickly and decisively in unique or surprising situations in their instructional settings. Although experience is acknowledged it has not become a research focus until recently. Perhaps this is due to the view that teachers are simply delivery agents. That is, a teacher's main goal is to fulfill a curriculum developer's purposes. However, it is also true that often intended curricula and resulting curricula are dramatically different. Why?

The Theory and Practice Relationship

Theories are generalized statements that may explain observed phenomena or predict future events. Practice is taken to mean the kinds of things that a professional does. Practice also includes preparation for performance and the practitioner's development of a repertoire of expectations, images and techniques.

Schwab has developed the distinction between theory and practice in the context

of curriculum thinking (1970) and specifically in the context of science education (1974). When one theorizes, one abstracts certain generalities that are intended to apply to a wide range of situations over an extensive period of time and ignores particularities of specific situations. Competing theories, by abstracting different generalities, may provide different explanations for the same situation. For example, there are several theories of learning such as those of Piaget, Ausubel and Skinner. The "practical" as used by Schwab (1969) refers to the unique decisions that are made in specific situations and is concerned with choice and action whereas the theoretic concerns itself with knowledge. Decisions may be informed by several theories as well as the peculiarities of the situation in hand. If a theory is to be used it must be supplemented by the practical to take into account all the important anomalies that are not covered by the theory.

A curriculum developer outlines how a curriculum is best implemented and why it should occur in this fashion. The curriculum developer does not speak directly to the unique situation in a particular classroom with an individual teacher and a unique group of students or a particular student.

Roberts (1980) uses the concept of "theory-practice interface" to illustrate the difference between what a curriculum developer intended in a particular curriculum and what actually happens in the classroom. He discusses how the teacher "sees" the developer's curriculum through his/her own perspective so that the developer's views about the aims, nature of learning and knowledge may be read differently or may not be even noticed in the curriculum materials. The curriculum materials are modulated or changed by the teacher in terms of what it means to be a science teacher for this person, what is important to teach, how the teaching should be conducted, and so on. Thus, the

teacher's beliefs and principles are contextually significant to the implementation of the curriculum.

Schwab (1969) states:

My own incomplete investigations convince me that we have not the faintest reliable knowledge of how literature is taught in the high schools, or what actually goes on in science classrooms. There are a dozen different ways in which the novel can be read. Which ones are used by whom, with whom, and to what effect? What selections from the large accumulation of biological knowledge are made and taught in this school system and that, to what classes and kinds of children, to what effect? To what extent is science taught as verbal formulas, as congeries of unrelated facts, as so-called principles and conceptual structures, as outcomes of enquiry? In what degree and kind of simplification and falsification is scientific enquiry conveyed, if it is conveyed at all? (p. 15)

Schwab notes that a study of textbook adoptions will not inform us of what happens in classrooms because teachers select and alter material from textbooks thus changing the aim of the textbook. Lists of objectives will also not inform us of practice because either the objectives are so ambiguous that anything can be subsumed under their aegis or they reflect hopes as much as actual practice. Schwab calls for an extensive pattern of empirical study of classroom action and reaction which is not a basis for theoretical concerns about the nature of teaching or learning but rather as a basis for beginning to know what we are doing and not doing in our classrooms and to what effect. This study undertakes to compile some data about what two teachers are doing in their classrooms.

Theories-in-Use

Argyris and Schon (1974) have proposed the concept of theories of action which exist as espoused theories and theories-in-action. They have defined a theory of action in terms of a specific situation and a specific consequence intended in that particular

situation. A theory of practice, with practice being defined as a sequence of actions undertaken by a person to serve others, is a set of interrelated theories of action that specify for the situations of the practice the particular actions that will yield the intended outcomes. When a teacher is questioned about his/her theory of action, he/she will describe his/her espoused theory which may not be the same as the theory that actually controls his/her actions in the classroom, that is, the theory-in-use. This differentiation is important as it relates to the difference between having a teacher describe what he/she thinks he/she is doing and having someone actually observe what that teacher is doing in the classroom. Descriptions of classroom behaviour by the teacher will give information about espoused theories which are used to describe and justify behaviour whereas observations of classroom behaviour will give information about theories-in-use which are operational theories of action. Argyris and Schon (1974) found that individuals were mostly not aware of how their beliefs affect their behaviour and they posited that the incongruity between espoused theory and theory-in-use may be culturally as well as individually caused and maintained. In the current study, both interviews with the teacher and classroom observation were utilized to obtain information about what the teachers said they did in the classroom and what they actually did in the classroom.

Schon (1983) elaborates on the uniqueness of theories-in use:

The situations of practice are characterized by unique events. Erik Erikson, the psychiatrist, has described each patient as "a universe of one" and an eminent physician has claimed that "85 percent of the problems a doctor sees in his office are not in the book". Engineers encounter unique problems of design and are called upon to analyze failures of structures or materials under conditions which make it impossible to apply standard tests and measurements. The unique case calls for an art of practice which might be taught, if it were constant and known, but it is not constant. (p.16)

Schon (1983) describes how people go about the spontaneous intuitive performance of the actions of everyday life and show themselves to be knowledgeable in a special way. Their knowing is tacit; their knowing is in their action. Similarly the everyday working life of a professional depends upon tacit knowing in action. Every competent practitioner can recognize phenomena for which he/she cannot give a reasonably accurate or complete description. In day to day practice he/she makes innumerable judgements of quality for which he/she cannot state adequate criteria and he/she displays skills for which he/she cannot state the rules and procedures.

The practitioner develops what Schon describes as knowledge-in-practice. As original situations arise the practitioner may have to criticize his initial understanding of the phenomenon, construct a new description of it and test the new description by an immediate experiment. An artful teacher sees a student's difficulty in not understanding a particular biological concept, for example, not as a defect in the student but as a defect of the teacher's instruction. The teacher endeavours to address the presentation of the concept in a different manner. Schon calls this process reflection-in-action.

Practical Knowledge

Though there is considerable variation in the specific situations in which teachers work, teacher knowledge and its use can be illustrated. In planning their courses and in instruction we see teachers choosing among alternative materials, deciding how to adapt programs to the needs of particular classes, combining materials to make up new curriculum packages, writing units and putting these into use in the classroom. These materials often need further modification and rewriting after they

have been used with students. Sometimes carefully made plans are pushed aside to take advantage of a fleeting opportunity that manifests itself. In carrying out this work the teacher shows wide-ranging knowledge which increases as the teacher gains more experience. This knowledge encompasses first hand experience of students' learning styles, interests, needs, strengths and difficulties, and a repertoire of instructional techniques and classroom management skills. The teacher knows the social structure of the school and what it requires of both the teacher and the student, for survival and for success. According to Elbaz (1983) all of these kinds of knowledge as integrated by the individual teacher in terms of personal values and beliefs and as oriented to the teacher's practical situation, are termed "practical knowledge". Elbaz (1983) says:

I have chosen to use the term "practical knowledge" because it focusses attention on the action and decision oriented nature of the teacher's situation and construes her knowledge as a function, in part, of her response to that situation. (p. 5)

In talking about the content of teachers' practical knowledge, Elbaz uses five categories: knowledge of self, of the milieu of teaching, of subject matter, curriculum development and instruction. She further identifies five orientations of teachers' practical knowledge which are meant to reflect the way that practical knowledge is held and used. The five are situational, personal, social, experiential, and theoretical orientations.

The situational orientation is a body of knowledge that is oriented toward a particular practical context, that is, to specific situations, tasks and purposes. The personal orientation sees the teacher as the ultimate practical authority on what students do in a classroom. This orientation encompasses not only intellectual belief, but also perception, feeling, values, purpose and commitment. This orientation thus is

motivated by the whole range of human feeling, need and desire and by the perspectives, points of view and system of constructs which are elaborated to deal with the world. The social orientation is reflected in the way the teacher moulds the subject matter to take account of ethnic or economic matters that influence students' expectations, interests and sense of propriety. Implicit in the situational, personal, and social orientations of teacher's practical knowledge is its experiential base. This orientation takes into account the teacher's style of teaching and his/her experience. The theoretical orientation refers to the idea that the teacher's knowledge is held in a particular relationship to theory. A teacher's academic training influences conceptions of theory, of valid knowledge and of research.

Elbaz further elaborates an internal structure to a teacher's practical knowledge consisting of three levels of organization. The levels of organization include: rules of practice which are specific directives, practical principles which are an intermediate level of generality and images which are broad metaphoric statements. Elbaz emphasizes that the structure of a teacher's practical knowledge is likely to be unique.

Clandinin (1986) builds on Elbaz's work by offering a conceptualization of image as a central construct for understanding a teacher's practical knowledge and for linking such knowledge to past experience and to ongoing practical expressions. Clandinin notes that teachers are said to do or think something in some particular way because of their "experience". She explored the experiences of two teachers in order to understand experience as it emerges in the form of images. Clandinin uses the concept of "image" as a dynamic symbolic system capable of organizing and transforming perceptual information. Images are seen to be a source of inspiration, ideas, insight, and meaning. Further, Clandinin notes that it is necessary to understand a teacher's practices within

a holistic context and that change in practice occurs as images find new forms of expression in practice. However the changes in a teacher's practice are such that the coherence of the whole is maintained. Thus, a student's experience is not with individual practices, but with the curricular environment as a whole.

Tobin et al (1990) conducted a study which described ten weeks in the classrooms of two teachers from five different perspectives including: teaching metaphors, gender differences, engagement patterns, classroom environment, and cognitive demands. A team of six researchers visited the classes at various times and the research team continued to interact with the teachers for one year after the data collection phase was completed. Data collecting strategies involved observing classrooms, interviewing students and teachers, working with students during classes, obtaining written responses to specific questions, examining student notebooks and test papers, and analyzing teacher assessments of student performance. Their findings emphasize the importance of teacher mind frames as well as the effects of the way in which the curriculum was conceptualized and implemented. The researchers also linked student views of the classroom to the metaphors, beliefs, knowledge, and practice of these teachers. From this linkage the researchers inferred the importance of the teacher's knowledge of content and knowledge of how to teach that content. This study suggested that the use of metaphors to conceptualize teaching roles raises the possibility that changes in classroom practice are possible if teachers are assisted in understanding the roles of science teachers in terms of new metaphors. This finding is similar to that of Clandinin (1986).

A study by Cornett et al (1990) investigated personal practical theories which are defined as "the systematic set of beliefs [theories] which guide the teacher and come

from prior life experiences [personal] and classroom experiences [practical]" (p. 520). This study revealed that personal practical theories may be enacted singly or in combination as guides for what the teacher did in the classroom. Like Schon's (1983), Elbaz's (1983) and Clandinin's (1986) findings, the teacher was not aware of holding these understandings and had not formally articulated them. As a result of informing the teacher of his/her implicit theories, this study shows how knowledge of personal practical theories allows the teacher to understand what guides his/her teaching; to examine the appropriateness of personal practical theories and if the teacher wishes, take steps to change his/her practice. Thus if a teacher knows what comprises the elements that guide practice the teacher is given a powerful key to improving practice. The studies mentioned in the previous pages provide evidence that teachers hold a complicated practical set of understandings which they use to actuate the work of teaching.

Paradigms

Kuhn (1970) seems to have been the first to use the term "paradigm" in his analysis of scientific practices. In the postscript to his book, Kuhn notes that he uses the term "paradigm" in two different senses:

On the one hand, it stands for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community. On the other hand, it denotes one sort of element in that constellation, the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science. (p. 175)

The study of paradigms, according to Kuhn, prepares the science student for membership in the particular scientific community in which he/she will later practice. The science

student is introduced to a common set of practices, techniques, routines, and exemplars that are provided by the current paradigm. Commitment to the same rules and standards for scientific practice are prerequisites for the continuation of a particular research tradition. Kuhn notes that scientists would likely state that they are bound by a set of theories but for Kuhn this term is inadequate and therefore he has devised the term paradigm to include models with associated analogies and metaphors as well as values and exemplars which are examples of how the scientist's job is to be done. Kuhn (1970) and Polanyi (1969) both point out that scientific activities need not be, and in most cases are not, guided by explicit rules. Giving the student only the rules will not enable him to do the science; doing science and learning the rules together results in tacit knowledge. The use of many technical skills in scientific research is a matter of tacit reliance upon commonly shared exemplars which are used as models for further activity.

When the accepted beliefs, values, techniques, routines, and exemplars are found to be inadequate for proposing solutions to problems, the profession reconstructs the field from new fundamentals and changes its generalizations, techniques and exemplars. There is a decisive difference in the solution methods. The profession is said to have experienced a paradigm shift and now looks at problems through a new perspective.

Imershein (1977) extended the concept of paradigm and paradigm shift from Kuhn's analysis of scientific practices to an analysis of organizational change generally and health care delivery specifically. Imershein extended Kuhn's line of reasoning by relating the demands of a particular situation with the technological skills characteristic of a particular organization and deciding on a particular course of action. The context of practice thus clarifies the use of the principles. By likening teaching to a process like

doing science or organizational change, the term paradigm might be used to encompass the beliefs, values, metaphors and exemplars that are used by a teacher to decide how to teach in a particular situation.

Crocker (1983) advanced the notion of "functional paradigm" as a means of investigating why classrooms function as they do. Crocker has proposed that research on teaching be directed to identifying the functional paradigms of teachers. He states:

Following Imershein's line of argument, it is assumed that teachers are, indeed, similar to other communities of scholars or practitioners in that they share common goals, problems, exemplars, routines, etc. which constitute a "functional paradigm". The use of the term "functional paradigm" is meant to convey the idea that the characteristics which unite a community of practitioners is likely to be centred on practical matters.

(p. 354)

The idea of exemplar or models of action that one has encountered before and that can be applied to a current situation that is seen as similar seems to be a crucial element in the notion of paradigms, theories-in-use, practical knowledge, and personal practical theories.

Benson (1984) investigated teachers' and students' understanding of biology by examining their conceptions of biology. Three biology teachers and 18 students participated in the study. The research methodology consisted of observing and audio-taping the teachers lessons on nutrition as well as audio-taping informal discussions with the participants including one teacher's complete lesson. Partial transcriptions were completed on the lessons of the other two teachers. The researcher made written interpretations of the participant's conceptions of biology and validated these with the participants. Benson developed an analysis scheme based on Esland (1971) and Werner (1978) and grouped the participants according to the philosophy of biology that they

showed most often. The study showed that the three teachers held a modified positivistic position whereas seven of the students exhibited a modified Baconian image of biology, three students showed a modified positivistic view and three students exemplified a conceptual change view. The ideas of five students were not analyzed as these students chose not to provide a second validation.

For one teacher, biology is a logical structured process which examines questions which arise from observations of specific aspects of nature. Growth of biological knowledge occurs by a linear process which gradually adds new discoveries to previous ones. Another teacher's view of biology is reconstructed from textbooks and confirmatory laboratory exercises performed during university courses. Biological information is discovered by the scientific method and the teacher's function is to pass this information to students. In this teacher's view doubt, intellectual conflict, and subjectivity do not play a part. The third teacher's conception of biology also is that our knowledge is derived from sense experience and the scientific method is a process which results in knowledge that is known to be certain. However this teacher separates fundamental questions of the living condition from biology and assigns those questions to theology. Biology is viewed by this teacher as a descriptive science which uses a modified positivistic method.

Benson concluded that the majority of the participants in his study looked at biology in a positivistic manner in which the scientific method yields certain information. The teachers' lessons reinforced the student's conceptions. Generally the students adopted a view that coincided with their teachers. However, three students held views that suggested contemporary philosophical thought. They viewed biology as a constantly changing endeavour.

A study by Lantz (1984) investigated the nature of teachers' functional paradigms by examining the factors which influenced the interpretation of chemistry curriculum materials by three teachers. Both qualitative and quantitative data collecting approaches were utilized. The qualitative data were gathered from classroom observations and interviews with each of the three participants. Surveys were utilized to collect quantitative data from the students of the teacher participants and a selected sample of Alberta chemistry teachers.

Lantz found that these chemistry teachers highly valued teaching theoretical chemistry and placed a low value on teaching the nature of science and the science-technology-society aspect of chemistry. The teaching techniques chosen by these teachers stressed pedagogical efficiency, that is, a quick effective means of giving a clear understanding of concepts and principles, academic rigor, and student motivation. The scholastic background and experience in teaching different chemistry curricula were identified as being particularly pertinent in how the teachers interpreted the chemistry materials. The study appeared to indicate that chemistry majors used other materials that they knew about and relied less heavily on officially approved curriculum materials than did the non-majors. Teachers, who were chemistry majors, rated their background for teaching chemistry, especially laboratory work, higher than did those without a speciality in chemistry. Other factors that were significant in how the teachers interpreted the chemistry curriculum materials included the number of students the teacher taught, the number of different subjects taught, the number of colleagues in the school and the school resources. The use of audiovisual materials and worksheets seemed to be teaching strategies that were used to cope with large numbers of students. Some teachers said that they had difficulty having students perform laboratory exercises due

to inadequate facilities including the lack of laboratory aides to assist in the preparation of materials for student laboratory work. The study suggests that large science departments, particularly in big urban schools, tend to centralize decision-making and restrict the choices of individual teachers.

Tomkiewicz (1987) conducted a study on the functional paradigms of 28 high school biology teachers by using a modified clinical interview to identify the major points of the functional paradigm held by these teachers. He used the interview data and field notes to reveal the strategies employed in the teaching of a unit on human genetics. Three questionnaires were also used. One questionnaire identified basic information such as teaching experience, academic preparation, involvement in professional science teacher organizations, journals used in teaching, professional presentations and information on teaching strategies, and the teacher's perception of the students curriculum and teaching environment. A second questionnaire assessed the teacher's understanding of scientific methods, assumptions and limitations of science. The teachers' intellectual and emotional attitudes toward science were assessed by a third questionnaire. The interview transcripts, field notes and survey documents were systematically searched for relationships among assertions and an interpretation of their meaning. Major assertions were categorized into one of four commonplaces: teaching, learning, curriculum or governance.

The interviews revealed that these teachers were constantly updating their knowledge base in biology especially in areas such as human genetics. The tentativeness of knowledge as evidenced by the rapid evolution of knowledge in the field of human genetics was conceptualized by the idea that science teaches "how" to look for solutions to problems rather than providing answers to the problems. In the teaching of human

genetics, these teachers stressed the tentativeness of science through a historical approach; they stressed that content was important to understand process and that science teaches how to look for answers to problems or questions. These teachers integrated science with other disciplines and related the content to science-technology-society issues to provide meaningful learning episodes for their students.

The construct of functional paradigm is developed to interpret why the high school biology classroom functions as it does. Determining the thought processes, beliefs or values that biology teachers have for each of the four commonplaces enabled the researcher to make some interpretations as to why the teacher was using a particular teaching strategy rather than just a description of how and what was being done.

Franz-Lutzer (1990) attempted a gender-related analysis of the epistemological frameworks which govern the classroom functional paradigms of two women biology teachers. She found that one teacher's rationale for her understanding of science was a mechanistic understanding of the nature of science. Epistemologically, this understanding is part of logical positivism. However, Franz-Lutzer found a dualism in this teacher in that the teacher also incorporated a personal knowledge in her understanding of biology based on her intuitive feelings and her personal feelings about bearing children. This teacher was found to spend very little time giving notes for the students to copy; she preferred a conversational approach whereby she engaged the students in dialogue. She was found to direct questions to her students and then modulated her responses according to her knowledge.

The second teacher also incorporated a mechanistic understanding of biology. Content was presented as a collection of facts which are verified through experimentation. The prevalent mode of teaching that occurred in her classroom was a

direct lecture pedagogical style. The researcher found that few questions were directed to the class and even fewer questions were initiated by the students.

Background on Teaching

Teaching is generally conceded to be an intentional activity, one in which specific sorts of actions are employed with the intent that they will result in a desired result. Generally, two types of teaching can be distinguished: teaching which allows students to judge the truth of knowledge claims independently and teaching which leaves students dependent upon their teacher for judgments of truth. Variations of this basic distinction can be found in the literature.

Olson (1981) classifies science teaching by considering teacher influence or who is in charge in the classroom. He considers high influence teaching to be subdivided into two categories which he refers to as "teacher as prime mover" and "teacher as navigator". The teacher as prime mover role ensures that important information is transferred to the student during a process in which students pay attention to the teacher. This role ensures that students have a common base of content for ensuing examinations. The teacher acts as an authority on the subject and usually it is possible to cover the projected syllabus content with efficiency and without interruption. Teaching activities involved in teacher as prime mover include lecturing, note-giving and desk work which transmit and guarantee information and involvement. In the teacher as navigator role, the teacher controls the direction and point of the lesson while allowing student participation. The teacher thus ensures that the students end up with the right information and the correct ideas. Teacher as navigator activities involve

greater student participation than in teacher as prime mover activities and include question and answer sequences; student recitation of information and guided discovery.

Olson (1981) refers to his second category of science teaching as low influence teaching. In low influence teaching the point of the lesson is not straight forward and control over what is significant is shared between the teacher and students. No one has the answer by authority of expertise or role and the answer is discovered rather than pronounced. Progress toward enunciating the answer is slow. The students' work is practical and the intellectual level of engagement is high. Some activities involved in low influence classes include discussion lessons, student seminars, essays, social issues, and debates. In low influence teaching there is less emphasis on the importance of science content and examination preparation. Teachers engaging in low influence teaching face the dilemma of the unchanging goal of having students achieve high grades on external examinations and meeting parental, peer and administration expectations that students know a certain amount of science content.

Olson (1981) investigated eight science teachers as they were attempting to implement the English Schools Council Integrated Science Project (SCISP). The SCISP program assumes the teacher to be a guide in inquiry and therefore assumes that the teacher will conduct low influence classes. However, Olson found that the teachers viewed their role as being central to preparing students for examinations and as being high influence. The teachers resolved their personal dilemmas by transforming the curriculum materials so that they were more in line with their view of teacher role. In one case the project discussion lessons were translated into direct instruction and in another case into end-of-chapter homework questions.

This research suggests that the teacher views a curriculum through his or her

own perspective' so that the developer's intended viewpoints about aims, the nature of learning, and of knowledge may not be shared by the teacher and may not even be seen in the curriculum materials. The materials are interpreted by the teacher according to the beliefs and principles held by that teacher in terms of what it means to be a science teacher in a particular school, what is important to teach, how the teaching should be carried out and how learning occurs.

Shulman (1987) elaborates on this knowledge base for teaching by identifying the following categories of knowledge which underlie a teacher's understanding of what is learned and how it is to be taught:

- content knowledge;
- general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter;
- curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers;
- pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
- knowledge of learners and their characteristics;
- knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
- knowledge of educational ends, purposes, and values, and their philosophical and historical grounds. (p.8)

The primary source of the teacher's knowledge base is content knowledge comprised of the knowledge, understandings and skills that are to be learned by students. For example in the biological sciences, the teacher should know organisms, their structure and function, their place and effect in the environment and their means of adapting and evolving in this environment. In addition, the methods used by biologists to collect observations in the biological sciences and how new observations replace old

observations and thus create new knowledge are also a vital aspect of content knowledge.

The teacher must have a flexible and multifaceted comprehension of content which will enable him or her to make alternative explanations of the same concepts or principles. This idea seems to corroborate Schwab's (1971) concept of the arts of eclectic. The teacher must also be well versed in the materials and structures for teaching and learning including curricular scopes and sequences, tests and testing materials.

The teacher's knowledge base is further informed by scholarly literature devoted to understanding the processes of schooling, teaching and learning. For example, cognitive psychological research contributes to the development of understanding how the mind works to store, process and retrieve information. Knowledge about student misconceptions in the learning of biology is also an important contribution in the knowledge base. Thus, according to Shulman (1987) a teacher must comprehend the subject matter for themselves, they must be able to see it in new ways, reorganize and categorize it and make it concrete in activities, metaphors and exercises and in examples and demonstrations so that it can be grasped by students. Shulman (1987) presents the following model of teaching:

Comprehension

Of purposes, subject matter structures, ideas within and outside the discipline

Transformation

Preparation: critical interpretation and analysis of texts, structuring and segmenting, development of a curricular repertoire, and clarification of purposes

Representation: use of a representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations, and so forth

Selection: choice from among an instructional repertoire which includes modes of teaching, organizing, managing, and arranging

Adaptation and Tailoring to Student Characteristics: consideration of conceptions, preconceptions, misconceptions, and difficulties, language, culture, and motivations, social class, gender, age, ability, aptitude, interests, self concepts,

and attention

Instruction

Management, presentations, interactions, group work, discipline, humour, questioning, and other aspects of active teaching, discovery or inquiry instruction, and the observable forms of classroom teaching

Evaluation

Checking for student understanding during interactive teaching

Testing student understanding at the end of lessons or units

Evaluating one's own performance, and adjusting from experiences

Reflection

Reviewing, reconstructing, reenacting and critically analyzing one's own and the class's performance, and grounding explanations in evidence

New Comprehensions

Of purposes, subject matter, students, teaching, and self

Consolidation of new understandings, and learnings from experience (p. 15)

According to Shulman (1987) the teacher's job of transforming the subject matter as understood by the teacher into the minds of students involves at least four major aspects. These include (1) the preparation of the given text materials in light of the teacher's understanding of the material, (2) representation of the ideas into new analogies and metaphors, demonstrations, and laboratory exercises that are likely to bring about student understanding of the subject matter, (3) instructional selections from among an array of teaching methods and models including lecture, demonstration, seatwork, cooperative learning, project methods, and (4) adaptation of these representations to the general and specific characteristics of the children to be taught. Once the teacher has transformed his/her comprehensions into a lesson plan, the actual instruction begins. Instructional activity involves the observable performance of the variety of teaching acts including organizing and managing the classroom; presenting clear explanations and vivid descriptions; assigning and checking work; interacting effectively with students through questions, answers, reactions, praise, and criticism. After the instruction is complete the teacher must check for understanding of what had been taught. Evaluation includes the constant checking for understanding or its lack that

a teacher uses during the process of teaching as well as the more formal testing and evaluation that is used to provide feedback and grades. Appraisal is also directed at one's own teaching and at the lessons and materials employed in the process of teaching. Finally the teacher looks back at the teaching and learning that has occurred and reconstructs and recaptures the events and accomplishments. It is through this process of reflection that a teacher learns from experience. As noted previously, Schon (1983) called this appraisal reflection-in-action.

Chapter Summary

The literature suggests that teachers "see" a curriculum in terms of what it means to be a teacher as well as what is important to teach and in what specific way. Schwab (1969) has suggested that study of classrooms be undertaken to compile data on what teachers are doing in classrooms and to what effect. Theories of action, proposed by Argyris and Schon (1974) are about particular actions that are undertaken by teachers to elicit particular outcomes. They observed that what teachers said they did and what they actually did in the classroom differed. Schon (1983) suggested that what the teacher actually did in the classroom was based on tacit knowledge and he described this as knowledge-in-practice. Knowledge-in-practice is modified by a process called reflection-in-action when and if the intended outcomes are not realized. Elbaz (1983) described "practical knowledge" as knowledge of students, of the social structure of the school as well as knowledge of a repertoire of instructional techniques and classroom management skills. She described teacher's practical knowledge as being organized in three levels including specific directives called rules of practice, practical principles

of an intermediate level and broad metaphoric statements called images. Clandinin (1986), Tobin et al (1990) and Cornett et al. (1990) have conducted studies which have shown the importance of images in the shaping of a teacher's practical knowledge.

Extending the work of Kuhn (1970), Imershien (1977) and Crocker (1983) have applied the idea of paradigm to activities associated with delivery of health care services and teaching respectively. Kuhn's concept that professionals have to be shown how to do something via exemplars appears to be the crucial unifying theme of theories-in-use, practical knowledge and personal practical theories.

Several studies (Behson, 1984; Lantz, 1984; Tomkiewicz, 1987; Franz-Lutzer, 1990) suggest that teacher's knowledge frameworks, understandings and beliefs are very important in guiding teaching and classroom practice.

The literature suggests that teaching follows two main patterns: teaching which allows students to judge the truth of knowledge for themselves and teaching which leaves students dependent on their teacher for judgments of truth. One variation of this pattern is enunciated by Olson (1981) in which he describes teaching as being either low influence or high influence. In high influence teaching, the teacher is the authority for judgments of truth whereas in low influence teaching students are allowed to judge knowledge claims independently. Olson's research seems to substantiate the view that a teacher's perspectives and principles are the basis of the kind of teaching that occurs.

Notwithstanding whether the teaching is low or high influence, Shulman (1987) proposes a general model of teaching that involves six main categories: comprehension of subject matter structures; transformation of the subject matter; instruction including management and observable forms of classroom teaching; evaluation including both that of students and teachers; reflection; and new comprehensions as a

result of the reflection that occurred. This model encompasses the guidelines that direct what the teacher does in the classroom and can be inferred to represent the teacher's functional paradigm.

CHAPTER III

DESIGN OF STUDY

Introduction

This chapter presents the rationale of the study, an outline of the data collection methodology including the procedures and reasoning used for selecting the teacher participants, the approvals necessary for gaining entry to conduct the research, the schedule for conducting the teacher observations, interviews, and audio-tapings, including which level of biology class, the length of each as well as the number of classes observed, an outline of the methods used to analyze the data, and the approaches used to establish the trustworthiness of the research.

Rationale for the Study

The intent of this study is to portray functional paradigms of two selected teachers of senior secondary school biology by identifying the characteristics of the teachers' functional paradigms and assessing how these characteristics are effected into classroom practice. The foundation of this study is premised on Schwab's (1969) call for an emphasis on researching the practical, that is, a study which attempts to uncover what two selected teachers are doing in the classroom. The researcher utilized Kuhn's (1970) concept of a paradigm as the entire constellation of beliefs, values, routines, and exemplars that guide a scientist in his puzzle-solving work and Crocker's (1983) reformulation of paradigm to functional paradigm as the shared characteristics which

unite a community of teachers and are centred on practical aspects of teaching as well as his idea that identification of the elements that are considered important by teachers for smooth classroom function can lead to an explanation of teacher behaviour.

In the human sciences, three main research orientations have emerged: empirical-analytic (technical), situational interpretative and critical (Aoki, 1978). The three orientations are differentiated by Aoki on the basis of cognitive interests, knowledge form, human/world relationship, and evaluation. The interests typical of each orientation exemplify the purpose of that type of research. In the empirical-analytic (technical) orientation, the interest lies in controlling the phenomenon being investigated. This approach is the traditional one utilized by scientists to compile data about events in the world. It yields facts, generalizations, cause and effect laws, and theories which result from humans acting upon the world which is viewed as an object. The knowledge that is gained is certain and predictable. This orientation is sometimes called experimental or quantitative research (Merriam, 1988).

In the situational interpretative research orientation, the research interest is in the meanings that humans give to experienced situations. The derived knowledge is one of the meaning that people give to an object or occurrence and reality is intersubjectively constituted between humans and their social world. This orientation is also called nonexperimental or qualitative research.

The critical research orientation is interested in improving the human condition by exposing hidden assumptions of why humans do things in certain ways and changing detrimental ways to improve the human state. The knowledge that results from this research orientation embodies thought and action.

Elucidation of the teacher's functional paradigm relegates the present study to a

situational interpretive or qualitative research orientation because of interest in the meaning attached to classroom practice. According to Bogdan and Bilken (1982) qualitative research is descriptive and the qualitative research approach demands that the setting to be studied be approached with the assumption that nothing is trivial, that everything has the potential of being a clue that might provide a more comprehensive understanding of what is being studied. The collected data is in the form of words and the written results of the research contain quotations from the collected data to illustrate and substantiate the final presentation. The qualitative researcher is concerned with process rather than outcome or product. That is, the qualitative researcher desires to determine how a particular action or meaning came to be. The researcher builds a picture which evolves as many disparate pieces of data are grouped and interconnected. Meaning is of essential concern to this approach and the qualitative researcher is interested in accurately portraying the perspectives of the participants. By learning participants' perspectives, qualitative research illuminates the inner dynamics of situations - dynamics that are often invisible to the outsider. Qualitative studies generally are hypothesis-generating rather than hypothesis-testing (Merriam, 1988). That is, the researcher, using the qualitative approach, does not enter into the study with particular hypotheses that he or she desires to have tested. Rather the researcher may build a theory or abstraction from the evidence as it is collected and analyzed. This particular research study was envisioned as building a picture of functional paradigms of two selected participants from interview data, audio-tapings of classroom interaction and descriptions of classroom happenings in the form of field notes. The researcher did not enter into the study with any particular hypotheses of what constituted the functional paradigms of the participants nor how the elements of functional paradigms would affect

interpretation and implementation of the biology curriculum.

A case study was selected as the most appropriate design for this work because the problem seemed to meet the criteria of case study research as outlined by Merriam (1988, p. 9). The questions that initiated the study were of the "why" orientation. There was minimal control in attempting to determine functional paradigms, the end result was envisioned as a description and interpretation of a bounded system, that is, the detailed examination of a teacher's functional paradigm in one setting consisting of the classroom (Bogdan and Bilken, 1982; Merriam, 1988).

Data Collection

The process of framing the questions to be asked in the study was predicated on a modification of Schwab's (1973) four commonplaces - subject matter, teachers, learners, and milieu as shown in Figure 1. The commonplace represented by the teacher portrays characteristics of the teacher, that is, some evidence about what the teacher is like, his/her values, beliefs, and commitment. This commonplace seeks to describe the teacher's scholastic background, attitude toward education, the teaching strategies the teacher chooses, and outside commitments that the teacher may have. The student commonplace identifies the teacher's expectations and role for the student as well as the inter-relationships between the subject matter and the students. The curriculum commonplace identifies the teacher's view of what the content of the subject matter is purported to be as well as the strategies and resources the teacher utilizes to convey this subject matter to students. This commonplace also incorporates how the teacher conveys

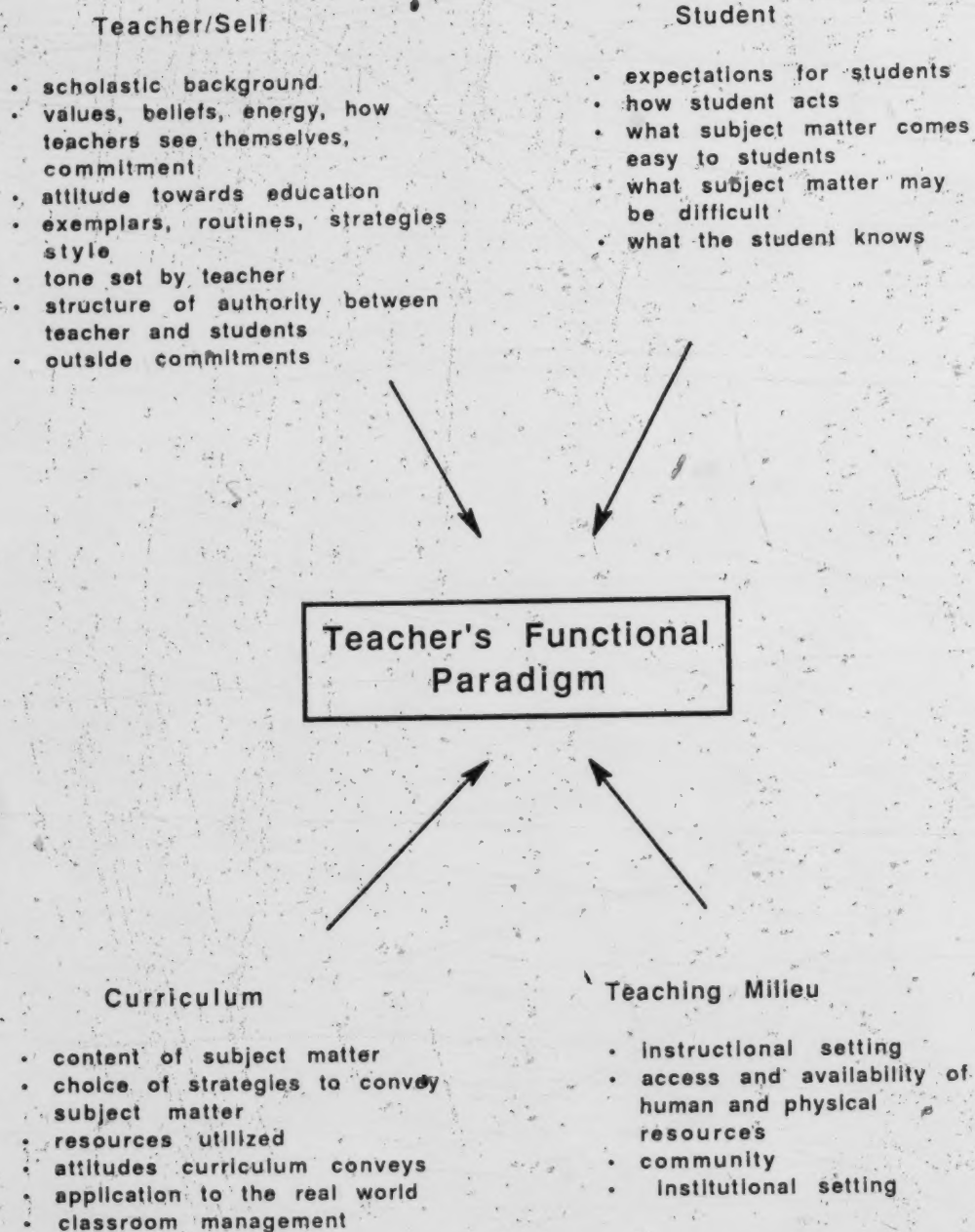


Figure 1. Factors that affect teacher's functional paradigm. (Modified from Schwab, 1973)

attitudinal and application aspects of the subject matter as well as how the teacher manages his/her classroom. The commonplace represented by the teaching milieu describes the instructional setting and the community in which the setting resides as well as the access and availability of human and physical resources.

The teacher's ideas about subject matter, the learners, the milieu as well as data about the teacher himself/herself was necessary to try to determine the characteristics of the functional paradigm. The first step entailed determining elements of functional paradigms as interpreted from the teacher's statements. The methodology employed four audio-taped interviews with each teacher which were later transcribed. It was thought that these interviews, each of approximately one-hour duration, would be adequate to determine the characteristics resident in the functional paradigm and to elude the values and world views of the teacher participant. It was also felt that the teacher would be willing to devote this amount of time without undue hardship on the other demands of teaching. An interview with the school principal gathered additional background information about the milieu.

The second step was to discover the extent to which the inferred elements were actually resident in classroom activity and discourse. This aim was accomplished by the researcher keeping a journal of field notes and by audio-taping the classroom interactions that occurred over a period of time. Analysis of the audio-taped interviews, the audio-taped classroom interaction and the field note observations was anticipated to yield knowledge about the relationship between the proclaimed teacher views of classroom function and observed classroom operation. This was necessary because research (Argyris and Schon, 1974) has shown that what some professionals say they do differs from what they are observed to do.

It was also important to establish how the characteristics of the functional paradigm were established in classroom practice. What the teacher does and says during the introduction of the course to the students sets the stage for the ensuing days and months of coursework. Actions that are initiated on that first day, as well as discussion about proposed actions that the teacher has in mind, inform the students about the paradigm of the teacher. Observations and audio-taping of classroom interaction on the first day of classes in each of the courses were utilized to gain insight into this aspect of the functional paradigms.

Participant Selection

This qualitative study consists of two case studies in which the major data-gathering technique is participant accounts of their professional lives as recounted through interviews and supported by audio-taping of classroom interaction and written field notes of classroom observation. The focus of the study is on two senior secondary school biology teachers working mainly in their classrooms. Selection of the participant teachers was based on the following criteria:

1. The researcher should know and respect the teacher participants. This criterion was based on the idea that entry into the professional life of the teacher would be smoother and less disturbing than if entry was attempted with someone who was unknown to the researcher. It was felt that a relationship of trust should already be established between the participant and the researcher. The building of rapport between people takes time and a harmonious relationship previously experienced was likely to enhance the data-gathering in this

research.

2. The participants be senior secondary school biology teachers. Since high school biology is the researcher's area of expertise, more meaningful discussions could be initiated because the researcher shared with the participants common teaching experiences including successes, concerns and problems as well as a common professional language. Elements of common school culture would allow an inside and an outside view. That is, because the researcher is a senior secondary school biology teacher, the researcher could experience what was happening as a teacher but could also make observations. Sharing a similar collegial teaching experience is likely to enhance professional credibility in the research.

3. The participants be articulate individuals who are willing to express and share their views and their classrooms with the researcher. This research project relies heavily on data gathered about the teachers through the interview process. Thus it is necessary that the participants are able to speak intelligibly about themselves as teachers and their teaching. Since the participants entered into the research project on a voluntary basis, it was necessary that they be willing to devote a certain amount of time and energy to the research as well as to "risk" sharing themselves.

Obtaining Permission

Informal discussions about the nature and purpose of the research project took place with each teacher. Then the teachers decided whether they wanted to take part.

Originally four teachers - two women and two men - were selected but one of the teachers decided not to take part and another was only somewhat interested in the research project. It was decided to proceed with two case studies. After obtaining preliminary consent from the teachers, official permission to enter the teachers' classrooms was sought from the two school jurisdictions - Edmonton Public Schools and Edmonton Catholic Schools - as well as from the two principals of the particular high schools that were to be involved. Separate Cooperative Activities Program Research Application Forms were completed for each jurisdiction. At the same time an application for an ethics review of the research project by the Department of Secondary Education at the University of Alberta was sought. All requests were approved. Special permission to enter the schools on the first day of classes was necessary because both school systems have guidelines which discourage research within the first three weeks in September. This necessitated a round of telephone calls to obtain this permission verbally first from the teachers and secondly from the principals of the involved schools. Teacher approval was granted and was largely due to the rapport and trust relationship that was already established between the researcher and the selected teacher participants. All official permissions from the school jurisdictions had to be granted before the third week of June, 1987 (before the commencement of summer vacation) so that entry could commence on the first day of class in September. Commencement of the approval process had to begin at the end of May in order to meet the requested amounts of time that are required for each step.

In addition to discussing the proposed research study with each teacher, each was also given the research proposal. Pseudonyms were chosen by the participant and researcher to ensure anonymity as far as possible.

Parents of the students in the observation classes were informed of the nature of the research via a letter and permission to audio-tape the student-teacher classroom interaction was sought. A copy of this letter appears in Appendix A-1. This letter was distributed to the students upon coming to the first class and return was requested as soon as possible. I proceeded with the audio-taping on the first day of classes with the assumption that if permission for audio-taping a particular student was denied, that part of the audio-tape would not be used. All permissions were positive in Catherine's school whereas two were negative in Tom's school but because these audio-tapings were going to be used in a support role this was not deemed to be a major stumbling block. All request forms were eventually returned but the students in both schools required several reminders from the classroom teachers about the need to have the forms returned.

Teacher Observations

Table 1 Timeline of Data Collection in Chapter 1 outlines the schedule of observations and interviews which was conducted over a two and a half-month period from the beginning of September to November. The observations with each teacher were scheduled so that the researcher could observe the first meeting of each teacher with his or her classes. Observation of introductory classes was for the purpose of ascertaining how characteristics of functional paradigms were established and communicated to the students. Thus it was important to observe how the teacher initiated the course work that was to follow in the subsequent months. As well, classroom observations were arranged so that the researcher could observe the implementation of one unit of subject

matter from its beginning to its conclusion which was signalled by an examination. This intention was not strictly adhered to and observation included more than one complete unit of work. The length of the observations was governed by one teacher desiring me to observe an interactive debate in one case and the other teacher wanting me to participate in the field trip in the other. Table 2 summarizes the classes and total number and length of periods of classroom observations.

Table 2
Summary of Classes, Number and Length of Periods Observed

Course	Number of Periods	Length (Minutes)	Total Minutes
Biology 10X	15	64 minutes	960 minutes
Biology 20	11	82 minutes	902 minutes
Biology 30	16	64 minutes	1024 minutes
Biology 30	13	82 minutes	1066 minutes

Observation of classroom interaction and activity was important in establishing the extent to which espoused characteristics of functional paradigms were present in classroom activity and discourse. The schedules of both teachers were such that I stayed at the respective schools over the noon hour. This proved to be valuable because I was able to observe the dynamics of interaction between the participant teachers and their colleagues as well as teacher-student interaction during an unscheduled time. The latter was an important aspect of Catherine's functional paradigm.

I was formally introduced by each teacher to the students in each of the classes and given time to discuss my study. During each teacher's presentations I sat to one side

of the classroom and toward the back, took field notes and audio-taped classroom interaction except for the times I became so engrossed I forgot to turn on the tape recorder or the technology failed due to weak batteries! I did not audio-tape during the fieldtrip, during slide-tape or video cassette presentations or during quizzes or examinations. When students were engaged in laboratory work I circulated among them and provided assistance when requested. Generally, the students ignored me but were very aware of my presence and what I was doing as was evidenced by their interactions with me when they drew me into their conversations. I was often greeted by name in the hallways. Aspects of academic and personal histories of the teachers were obtained in an informal untaped interview by asking the questions outlined in Appendix A-2. This data appears in the section which introduces each of the teacher participants. Description of the teacher's workplace was obtained by completing an observation sheet of classroom setting as outlined in Appendix A-3. Background information about the school, its programs and the nature of its community was obtained by interviewing and audio-taping the principal of each school. The taped interviews with each of the principals were summarized and pertinent data incorporated into the section describing each teacher's milieu. The framework questions for these interviews are outlined in Appendix A-4. Frequent informal interactions with other teachers and the laboratory assistants occurred in the office area and/or staffroom. These interactions were not taped and field notes were made only in one case relating to iconic symbolization.

The Formal Interview

The interview is used as the main technique to gather descriptive data from the participants concerning the characteristics of the functional paradigms as interpreted in the teachers' own statements. The interview data were also important in determining the values and/or world views which influence the teacher's interpretation of biology curriculum. Four formal interviews, each of approximately one hour duration, were carried out with each teacher. The interviews were spaced to coincide approximately with the first week of classroom observations, the middle of the observation period and the latter part of the observation period. The discussion questions were open-ended in nature and often began from a conversation between the teacher and myself as we settled into our interview surroundings. A framework of questions, as outlined in Appendix B-1 and Appendix C-1, was prepared prior to the interview and served to initiate and guide our dialogue. Many of the questions arose from observed classroom events, thus the interview questions are slightly different for each of the teachers. The dialectical exchange was allowed to shape the content of large portions of the interview. The questions were organized around an adaptation of Schwab's (1973) four commonplaces as outlined in the design of the study. All interviews were audio-taped and transcribed. Transcripts of the formal teacher interviews are presented in Appendix B and Appendix C. In the case of Catherine, we were unable to complete one interview in the time that we had and we concluded it during a conference that we both attended a few days later. These became Interview I and II. Because Tom was ill on one occasion, I did not want to overtax him and we concluded Interview III at another time. This became Interview IV. Interviews were scheduled during teacher preparation periods or during the noon hour.

To gather information about the relationship between espoused teacher views of classroom function and of observed classroom function, the interview data, observation field notes and audio-tapes of classroom activity were compared.

I received exceptional cooperation and the teachers appeared eager to contribute during the interview process. I was always greeted with the offer of coffee or tea refreshments and my stay within the school was made pleasurable and very comfortable.

Data Analysis

Transcription of interview data was a time-consuming task. However, I felt that it was important for me to undertake this task and therefore intimately acquaint myself with the nuances and expressions of the conversations taking place. Information about my own speech and thought patterns were as revealing as those of my interviewees. Hesitations of speech, slang expressions, and repetitions were transcribed intact, however many run-on sentences were fragmented and punctuated to make it easier for readers to follow the expressed thoughts. This process became easier as I progressed through the transcriptions.

Major interruptions are noted as such in the transcripts and parts of conversations that were unintelligible despite numerous attempts to decipher them are also indicated. The second interview with Catherine was conducted in a laboratory room and was often interrupted. Significant movement of people through the room made the situation uncomfortable particularly for the interviewer.

The interview transcripts were read many times. To begin the elucidation of the functional paradigm, concept maps were constructed which depicted what the teacher

participants said about each of the four commonplaces: the teacher, the student, the subject matter, and the milieu. Examples of what the participants did in the classroom with regard to what they said they did were extracted from the audio-tapings of classroom interaction and the field notes. Data about the milieu were supplemented with information from interviews with the school principals and the observation sheets. Routines which the teachers followed were developed from the transcript and field note data. Values and/or world views of each teacher were highlighted from the interview transcripts and the values were related to what the teachers said about their practice during classroom interaction with the students. Lastly detailed summaries and/or transcripts were made of the interactions during the first day of classes in the semester. These were utilized to demonstrate how the values and routines of the teacher participants were evident during the first day of classes and were reinforced in the subsequent periods in the courses.

Trustworthiness

The issue of trustworthiness is important for inquiry in both quantitative and qualitative research because it is necessary that the results be trusted and that readers feel confident about the findings in the study. Traditionally, research studies address four issues related to the trustworthiness of the research:

1. Internal validity (truthfulness or credibility)
2. External validity (applicability or transferability)
3. Reliability (consistency or dependability)
4. Objectivity (confirmability)

In qualitative research internal validity relates to the truth or credibility of the study and it is the qualitative researcher's obligation to present an honest rendering of how participants view themselves and their experiences. This rendering can be enhanced by the process of triangulation - a method of using multiple investigators, multiple sources of data or multiple methods to confirm the emerging findings (Jick, 1979). Member checks (Merriam, 1988) which involve taking data and interpretations back to the participants to determine whether the data is accurate and the results plausible is another way of checking whether the findings capture what is really there. Collecting data over an extended period of time provides opportunities for repeated observations of the same event or phenomenon. Repeated observations of the same event or phenomenon decrease the probability of these phenomena being chance occurrences. In this study internal validity is assured through the use of multiple sources of data - interviews, audio-taping of classroom interaction and field notes - as well as member checks with the teacher participants and an extended observation period with each teacher.

External validity - applicability or transferability - is concerned with the extent to which the findings of one study can be generalized to other situations. A case study, and qualitative research generally, struggles with this definition of external validity in that there is question of whether one can generalize from a single case, or from qualitative research. This study has accepted Wilson's (1979) idea of reader or user generalizability. This means that the researcher must provide a detailed description of the study's context so that the reader can determine what applies to his or her own situation and what does not.

Reliability is sometimes called consistency or dependability and refers to the extent to which the findings in the study can be repeated. Because a case study and

qualitative research generally is a photograph of a particular instance at a particular time, reliability in the traditional sense is problematic. Guba and Lincoln (1981) make a case for short-circuiting reliability in favor of internal validity:

Since it is impossible to have internal validity without reliability, a demonstration of internal validity amounts to a simultaneous demonstration of reliability. (p. 120)

Rather than asking another study to replicate the results, one wishes that other researchers will agree that, given the evidence collected, the findings make sense, are consistent and dependable. According to Merriam (1988), the results of a case study can be made reliable by explaining the assumptions and theory behind the study as well as the basis for selecting the participants, a description of them and the context in which the data were collected. Triangulation strengthens not only the internal validity but also reliability. Detailed descriptions of data collection and decisions made allow others to follow in the researcher's footsteps and replicate the study as nearly as is possible.

Objectivity is contrasted with subjectivity. Subjective refers to what concerns or occurs to the individual subject and his experiences, qualities and dispositions while objective refers to what a number of subjects or judges experience thus rendering the phenomena to the public domain. Thus, if multiple observers can agree on a phenomenon, their collective judgment can be said to be objective. The experimental methodology of quantitative research also improves objectivity. Lincoln and Guba (1985) apply a qualitative sense to objectivity in qualitative research by referring to the quality of the evidence or report. This application places the emphasis on the characteristics of the data rather than the investigator by asking whether the data are confirmable. Triangulation aids in meeting the criteria of objectivity or confirmability.

CHAPTER IV

FINDINGS

Introduction

This chapter is concerned with identifying characteristics of functional paradigms of the two selected teacher participants, elucidating the teachers' values and/or world views and how these influence classroom practice, comparing the elements as espoused by the teachers with observations of the teacher in the course of classroom function as well as determining how the teacher communicates characteristics of a functional paradigm to the students during the introductory classes. Findings about Catherine will be followed by findings about Tom. Each case study utilizes excerpts from the interview data, classroom interaction audio-tapes and field note observations to present a picture of the teacher participants as teachers with their own view of students and curriculum in a particular setting or milieu and culminates in a description of the teacher's first instructional day of the semester.

Catherine's teaching environment, consisting of her classrooms and the laboratory room, is described first followed by an introduction to Catherine as a person. Catherine's views of students and a description of the accompanying school milieu is followed by Catherine's thoughts on education, biology and biology teaching. Routines and activities on laboratory and non-laboratory days are presented followed by a section on classroom management. This section about Catherine is concluded by a vignette depicting Catherine's introductory lessons during the first day of the semester. Table 3 and 4 outline the instructional activities in the Biology 10X and Biology 30 classes during the

observation period.

Table 3

Outline of Catherine's Biology 10X Classes

September 8	First day of semester Introduction of rules and regulations, course outlines, evaluation schemes, distribution of rental texts, checking of classlists, making a seating plan
September 10	Completed introduction Began microscope unit
September 14	Catherine absent; Did not observe
September 15	Laboratory exercise on care and function of microscope
September 17	Returned laboratory microscope exercise handed in on September 15, discussed and elaborated explanations of each question Exercise on size of objects viewed with microscope
September 21	Discussed measurement of very small objects (mm, μ m, nm, and angstrom)
September 22	Microscope exam
September 24	Discussed historical development of cell theory and associated technological development that aided knowledge about cells
September 28	Returned microscope exam and discussed exam
September 29	Laboratory exercise on making temporary mounts and viewing a variety of cells (onion, <i>Elodea</i> , cheek cells) Catherine went to Valley Zoo after school in preparation for upcoming field trip
October 1	Laboratory exercise continued
October 5	Slide-tape presentation on taxonomy Discussed bases of taxonomic groupings Distributed and discussed handouts in preparation for taxonomy field trip
October 6	All day taxonomy field trip at Valley Zoo

October 8	Discussion of field trip and completion of assignment on keying from field trip activities
October 13	Catherine late due to medical tests that she was undergoing Slide-tape presentation on species (I showed) Returned and discussed laboratory exercise completed on October 1

Table 4

Outline of Catherine's Biology 30 Classes

September 8	Introduction to Biology 30 with discussion of rules and regulations, course outline, evaluation schemes including diploma examination, distribution of rental texts Began first unit on cells
September 9	I missed class due to observation of Tom's introductory classes
September 10	Slide-tape presentation on cell organelles Discussion of cell organelles using cell diagram handout
September 11	Double block Discussed fluid mosaic model of membrane structure Completed discussion and labelling of diagram began previous day Slide-tape presentation on cell membrane function Students chose disease for disease assignment
September 14	Catherine absent for part of class Library orientation by librarian in library in preparation for disease assignment Osmosis demonstration and students made measurements on demonstration set-up
September 16	Interview I Discussion of variables, control
September 17	Discussion of pH, classes of organic compounds
September 18	Double block Interview with principal

- Discussion of carbohydrates and lipids
- September 21 Slide-tape presentation on proteins
Review of lipid synthesis
- September 22 Laboratory exercise on identification of carbohydrates
- September 23 Interview II
Students make notes on objectives
Filmstrip on DNA, RNA and protein synthesis
- September 24 Laboratory exercise on identification of lipids and proteins
- September 25 Double block
Hand in of laboratory questions
Review of previous work
Slide-tape presentation on enzymes
Biochemistry quiz in second block
- September 28 Returned and discussed quizzes
Slide-tape presentation on negative feedback of enzymes
- September 29 Laboratory using catalase enzyme
- September 30 Double block
Discussed catalase laboratory and told students that it would not
be handed in for marking
Discussion on feedback and feedback inhibition of
enzymes
- October 1 Examination on cell unit
- October 2 Catherine attends Science Conference
Conclusion of Interview II at conference
- October 5 Return and discussion of examination
Return and discussion of carbohydrate identification lab ,
completed on September 22
-

Catherine - The Teacher and Her Teaching Milieu

Catherine's Teaching Environment

Catherine teaches in a very spacious and bright room that has windows across the back wall. The front of the room has three large attached chalkboards plus a moveable one. One wall has large tackboards which contain hand-drawn diagrams (assumed to be student work but not necessarily Catherine's students as other teachers share the room), posters with catchy sayings, as well as biological posters including ones of recombinant DNA, the taxonomy tree, flow of energy, the scorpion and the lamprey, and several newspaper clippings. The room houses large plant stands, models on a big table, and flip charts at the front of the room. One wall is lined with cupboards used to store rental textbooks and other reference texts. Specimens in glass jars are placed on the cupboards. Students sit on chairs at small tables which are arranged in rows. Audiovisual equipment, including a film projector and a cassette-slide projector, are contained on a cart that may be transferred from one room to another. The floors are tiled and the acoustics are somewhat poor as often it is difficult to hear softly spoken student replies and/or comments if one is not at the front of the room. A teacher's desk is placed in the middle of the room at the front. A retractable screen is centred above the chalkboards. Two classrooms back onto a double laboratory room that could be separated into two rooms by sound-proof sliding panels.

The so-called "biology office", which likely was built to serve as a preparation room, adjoined the laboratory. It housed three desks that contained the personal property of three teachers (two females including Catherine and one male) who

primarily taught biology. Other teachers, who taught other assignments besides biology, came to this area to pick up audiovisual aides and models, to sign out laboratory time and to talk shop. A kettle, teapots and cups enabled the teachers to make tea or heat water for coffee.

The biology courses were taught by three full-time biology teachers and at least three other teachers who taught biology in addition to other assignments. The chemistry and physics teachers were centred in another area of the school. The male biology teacher, Scott, served as Science Department Head. The chemistry and physics teachers rarely came to the "biology office". A full-time female laboratory aide assisted all science teachers in setting up requisite laboratories. She devoted mornings to chemistry-physics preparations and the afternoon was spent on biology needs. Relations between the aide and the biology teachers were good and the aide was routinely invited to participate in field trip outings.

Introducing Catherine as a Person

Catherine is a teacher in her early thirties who has taught for a total of nine years. Unable to obtain a regular placement with Edmonton Public Schools, she taught for two years as a substitute teacher. This experience spanned all grade levels from elementary to grade twelve. All of her experience has been in the urban setting; she has been at her present location for six years. This is the same high school that Catherine attended as a student. She concentrated her post-secondary studies at the University of Alberta for five and one-half years obtaining a four year Bachelor of Science degree with a specialization in zoology; then by transferring to the Professional Diploma After

Degree (PD-AD) program for one and a half years, she obtained her teaching certificate. Catherine holds a permanent professional teaching certificate which was granted after two years of teaching practice. The last course that she has taken was a Cardio-Pulmonary Resuscitation (CPR) course in 1982. Staying current with changes in biology content involves reading popular magazines which report research, such as *Scientific American*, *Discover* and *Science Journal*, perusing various newspapers, attending conferences, and taking part in some workshops at the University of Alberta. She finds little time to read beyond material relevant to biology but when she does, it usually revolves around child-care topics. Membership in professional organizations includes the Alberta Teachers Association Specialist Council in Science; while committee membership includes the school's Courtesy Fund and Community Relations Committee. Catherine has been an active teacher advisor for the school's cheerleaders and has recently taken the club for world competition in Chicago.

Catherine is married, has one young son and is pregnant with her second child. She plans to initiate her maternity leave after the Christmas holiday. Her present part-time assignment (5/8 full time equivalent) includes teaching two Biology 30 classes and one introductory International Baccalaureate (IB) Biology 10 referred to as Biology 10X.

During her career, Catherine has taught all the approved Alberta biology courses as well as the International Baccalaureate Higher Level biology curriculum, Science 11, Chemistry 10 and Science 15 - a school-initiated course called "Current Issues in Science".

Catherine is well known and respected among her colleagues. She is often asked to pilot other teacher's projects as, for example, *Track Pack Two: Secondary Education*

Valley Zoo Field Trip Exercises by V. J. Romanyshyn and certain laboratory exercises in *Biology, A Canadian Laboratory Manual* by R. Ritter et al. She has been very active with the Alberta Department of Environment setting up a water study project called Aquatic Invertebrate Monitoring (AIM) which is being utilized by teachers province-wide.

Catherine is an articulate person who speaks in paragraphs. The following symbols are used in the transcriptions of interviews and class interaction audio-tapes:

.. significant pause

.... material left out

C Teacher Catherine

T Teacher Tom

I Researcher/Interviewer

S Student

The following excerpt from the first interview gives Catherine's opinion of herself as a teacher and as a person:

I: How do you see yourself as a person?

C: Well sometimes I would like to be certain things that I am not ... Basically I certainly feel that it is very important to get along with people. This doesn't mean giving in and doing things that I don't want to do. But giving and take. ... I see myself as a very, .. fairly gentle person. Deep down inside I have become very tender. I cry at the worst shows at the worst possible films in school for example, the birthing film. There are some very touching scenes in there and I have to quickly wipe my eyes before I get up and talk about this film to the class. So I am very sensitive. Sometimes I can become very angry. I do have a temper and that is one of the things that I don't like about myself. And one of the things that I am working on - to control this temper. There is no need to get upset about certain things. Sometimes very anxious. About certain situations. I think with maturity that is becoming less and less worrisome. Because as you have more experiences and you look back on them you realize "Why did I worry? There is nothing to worry about!" So that is some concepts of what I am. Very very anxious. Something that I am becoming a little more comfortable with in new situations and ..

I: Are you a perfectionist?

C: I would say not a .. I like organization. I like things to be done well. Perfect?

Sometimes it is extremely time-consuming and I wonder if it is worth spending the time putting in that little bit - that little bit more - to make it perfect. I could have spent that time doing something else. I like to do a good job - even better than good - I don't think that I ever reach the stage of perfection.

I: Would you describe yourself as a workaholic?

C: I'd say so. I'd say .. There are people probably that have a lot of talent and therefore don't have to work as hard. I think that I have an average amount of talent but that I do have to put in a lot of work.

Catherine substantiated her claim of being a sensitive person by describing a situation relating to a student confrontation she had experienced:

I: ... Have you had any particular personal struggles just because you are female? That perhaps you might talk about?

C: I think that at least initially the first year that I came to ____ there was a boy in my class and I'd say that was the most significant and the most gut-wrenching problem that I had. He was a poor student and a chronic misser of classes and he came to me and I think because I was a woman he thought that I would be a soft touch. And he wanted to enroll in I think it was a dance competition. Where he and his partner would dance and make funds and so on for .. it was a worthwhile cause. There was nothing wrong with the cause. But it was during classtime and of course teachers have to sign the form saying that yes they permit the student to participate. Well he was failing the course, he'd already missed many many classes so I couldn't in good conscience sign the form. So I told him that I couldn't sign the form and I did try to explain why. He of course got very hostile. And even his girlfriend came to see me about why wouldn't I let him participate in this worthwhile cause and you know that that is probably the furthest thing from his mind is the cause - he just wants to get out of class and have a good time - so I stuck to my guns though, but not after taking quite a bit of abuse from him - verbal abuse - so much so that even swearing, not to my face, but to another student of mine behind my back. Which was overheard by a student teacher that I had at the time. And that was really quite .. crushing. It was crushing. And that was the first time, I think, that my femaleness came out. I felt like how could somebody say .. I felt really really hurt. A man, I don't know if a male, would have been quite as insulted by that as I was to be called the kinds of names that I was. And you know, I felt that I had his best interests at heart. He couldn't see it that way and I think that was the worst, the absolute worst situation that I came across. I never really .. I became very bitter towards him. I thought .. He eventually did leave my class and I thought boy if he tries to get back in there, I just can't. I can't have him back in my class after he's done that. I don't know, a male might have responded differently. But I cried. That really broke me up. But I never.. I have never had a situation like that since. I think that some ways I've become, I think that it was because I was fairly young too, in starting out, I don't think that that kind of thing would bother me now.

Catherine thus describes herself as sensitive, anxious, gentle and one who likes to get

along with people. She describes her temper as one characteristic she does not like about herself. She says that she likes organization, does not feel that she is a perfectionist and agrees that she is a hard worker perhaps a workaholic. Catherine admires certain characteristics in other teachers:

I: I am going to ask you to think back to the teachers that you have had and I'd like you to think perhaps about some of the characteristics that you might have admired in them and I'd like you to identify what some of those characteristics might have been.

C: OK. Well if I have to be perfectly honest at the risk of embarrassing you, ..I think that you were one of the people that .. one of the first teachers ... at _____ that I did feel an attraction to. I liked your .. You came across very self-confident in the classroom, very knowledgeable, and I think when I started to think about teaching biology I thought about you. I thought about the characteristics that you had. Very professional and I thought that was a very important feature or characteristic that I thought that I should have as a biology teacher. Ah.. another one was (name of teacher). He had the capability to kinda spellbind his students when he taught the history. I can remember just sitting there listening - just listening to him and it wasn't, you know, it wasn't infatuation or anything like that with _____. It was with what .. with how he said it. With what he was saying and how he said it. And I felt that was something that made it really enjoyable to be in his class. Plus the fact that he related very well to the students. (name of teacher.) Who taught language was another one. Although I wasn't that .. I didn't have that much admiration for him in the classroom. In other words that's not where I really saw .. saw him. I didn't see him till after he had taught me. And his warmth and his friendliness and just so outgoing and mingling with the students. He wasn't upstairs in the staffroom. He was in the hallways and in his room. You could always find him to talk to. I admired that. You know that different teachers had different qualities that .. in a way some of the stricter teachers you know like really strict - I admired also because they didn't take anything - any guff - from any of the kids. So in a way I admire a certain amount of strictness in that the student doesn't pull the wool over your eyes. You know telling you things that aren't true. So I always.. somebody like (name of teacher) while he instilled the fear of God into kids and I .. you wonder if that is something to admire, something scaring people. But I think it kept kids knowing .. kept students knowing .. where they stood and what you could .. what you could do. What was proper and what was not proper. So in a way I admire that although less than the other - the other characteristics. Still I feel that it is important to stay on top of student's things like attendance and just make sure that they are doing what they are telling you that they are doing. And confronting them if they are not.

Characteristics which Catherine admires in others include being self-confident,

knowledgeable, relating well to students and being available to talk to them. As well, she admires warm friendly teachers and ones who exhibit a certain amount of discipline in their classes. Catherine models these characteristics. Without her admission that she was anxious one could not infer this from observing her. She seemed self-confident and knowledgeable. Other people within the school routinely sought her advice on biological concerns. Teachers who taught only one or two biology courses turned to her for advice:

This is illustrated by the following interview data:

I: Something that I have noticed is that people go to you as an authority - other teachers. For example (name of teacher). He didn't go to anybody else he went to you. He had to bypass several other people who could have just as easily have helped him. I noticed even (name of teacher) he tends to bypass others. Catherine will take care of this type of thing. How do you view that? From my perspective they seem to view you as an authority in biology.

C: I think it is because I have offered help. (Name of teacher) was new here last year and I did try to give him as much help as I could. I spoke to (name of teacher) too, when he first came and he was interested..and he had to teach the Science 11 and he wanted some help in getting started. So I think it is because I have volunteered some help initially and that is why they come back because they know that I have offered and I am willing to help them and that they are not infringing on my time that they come ask questions or how to book out this film or that film or what is coming in or what is available and so on. I think it's because they know that I have the information and am willing to give it to them.

The laboratory assistant volunteered that Catherine was known for her reputation as a teacher with a strong knowledge base. Catherine has had some work published and this has enhanced her reputation among colleagues.

Catherine was friendly with students in the hallways and stopped to talk to them on her way to the cafeteria. She was available to students during the lunch break for extra help. She explains in the following way:

I: You and actually the rest of the teachers in your group, in your school, work through your noon hour as if it were another class. Why do you do that?

C: ... Noon is the only time that a student can come in, ask questions, get some

help, get some supervision on the microscope or the labs or using labs and . . . It's their time really that they have. It's not that I'm not available after school. It's just that they might not necessarily be available after school so I don't even bother going up to the staffroom especially when I know the kids will be coming. I don't even get a chance to go. I get to the office and there they are!

Catherine spoke to students about lates by talking to them individually. However during the observation period few students were late. Catherine's voice was commanding, loud, and well-projected. I noted in my field notes that Catherine "speaks slowly with lots of emphasis." Students appeared to be involved with what Catherine said and were eager to answer and ask questions.

Catherine indicated that she liked organization and this was evident in what she did. Prior to the beginning of each class she prepared all the items that she would require to carry out that particular lesson. The audio cassette tapes were set up and ready to begin, handouts were neatly stacked in the order that they would be distributed, laboratory equipment was checked and Catherine even checked the state of the microscopes to be sure that they had been properly put away. Catherine had the whole semester planned so that she could tell you the order of the units, the approximate date of completion of each unit and when the unit examination would be administered. She always told the students in advance what they would be doing and when they would do it. Catherine ordered movies and other audio-visual aids at the beginning of the semester to coincide with the time that they were required. However she showed flexibility in this organization scheme when a field trip in Biology 10 to the zoo was proposed and she willingly altered the sequence of two units in order to accommodate this field trip.

Catherine's commitment and hard work were evident by the amount of marking that she did. During the observation period she marked two laboratory exercises, an examination and prepared for a field trip for the Biology 10X including an after-school

meeting at the field trip site. As well, she marked three laboratory exercises, a biochemistry quiz and an examination for the Biology 30 students. She also found time to administer the school courtesy fund and be a member of the community relations committee - a committee of school representatives and community members dedicated to the goal of improving relations between the school and surrounding community - which had one evening meeting during my observation period. Some time must also have been spent preparing for the classes although I did not observe this except for time spent before school began and during the noon hour preparing equipment. Catherine's commitment was also exemplified by the amount of time that she spent with students during the classes, during the breaks between classes and during the lunch hour. She rarely relaxed during these times.

Modelling behaviors is also important to Catherine. For example, being on time is important and therefore she makes every effort to be on time. She does not tolerate the same student being habitually late and during the observation period, lates and absences were few. Catherine picks up garbage in the hallways in the hope that students will take her behaviour as a hint to do the same. She explained:

C: I try not to pick up after the kids. Male or female. I'm not their mother and they want to live in a messy space so long as my space is neat and clean. ... When I do pick up like when I pick up things in the hallway and that I don't do it because I'm female but because I'm trying to set an example. To any of the kids that, you know, there is garbage on the floor. Anybody can pick it up and put it in the gargage. Maybe there are a few kids around that will see me picking this stuff up and putting it in the gargage..

On the idea of role models Catherine offered the following:

I: ... You try to be an example for students. You talked about a role model.

C: Yah. I try. I tried to.. as situations come up I try to demonstrate or to mention what the appropriate thing to do would be. ... That's a very hard thing to do. I find it very difficult to be a role model. Cause you fall down so much yourself.

I: You are only human.

C: Yuh. You are not perfect and you make lots of mistakes and sometimes you lose

your temper. So how can you be a role model for being a patient understanding person when you lose your temper. So you know I make lots of mistakes but that's who I am. But every year I come back and I say to myself "This year these are the things that you are going to change." When a student comes to you a student that you know you're angry with because they have done something and you know that they know better and when are they going to take the responsibility and just try not to take the offensive with them. That's the worst thing I know for making somebody withdraw even further is when you become defensive and reprimanding about how they handled the situation that you feel was inappropriate. And just to let go of your feelings and just try to.. try to get them to explain why they did handle things a certain way and get them to see what is or might be a better way to handle the situation. That is a very difficult thing.

I: Boy, I'll say it is.

C: And that is something that I would like to be able to role model because that is .. It's an art! It's hard to learn and very few people can do it.

In summary, Catherine had a strong knowledge base and was deemed an authority on biological matters by school personnel. She was friendly with students and available to them during the lunch hour by staying in the biology office next to the laboratory room. Tight organization, commitment to teaching, hardwork, and the modelling of exemplary behaviours were important features of Catherine's teaching style.

The School Milieu and Catherine's View of Students

There are 1200 students in Catherine's school. Located in a middle to upper middle class community, the school draws students from locations throughout the city and the student population represents a cross-section of all socio-economic conditions including many single-parent families. Because the school jurisdiction practices a no-boundaries policy, the students are solicited by advertising two main school features: (1) a strong academic standing and (2) a friendly atmosphere. The school is one of four schools in the city that offers a full International Baccalaureate (IB) program, a type of academic challenge program, which serves to entice students to the school. The school has a strong athletic program as evidenced by the multiplicity of championship banners

displayed in the school gymnasium. Forming a cosmopolitan community, the students represented 41 different cultures as shown by a "Multicultural Day" experienced in the previous year. According to the principal, many of the graduates attend a post-secondary institution, such as a university, institute of technology or a community college.

Catherine says, "I enjoy high school students." In fact, Catherine's positive experiences during her own high school education contributed to her choice of career:

I: Why did you become a teacher?

C: Coming out of high school, well not even out of high school, actually in grade twelve when students begin to think about what it is that they should be doing after high school I had always been very happy at school. I had always enjoyed it and done reasonably well. I always felt that I could have done better but I was the kind of person that I really enjoyed the social life of high school I wanted to have good marks and I would do the cramming technique the night before the exam. Worked really hard and then do fairly well on the exam. Not an honours student but just average, just an average student. I have always had a really good positive experience. Especially in high school. ... I thought "What's wrong with staying in school as a teacher?" You have an environment you can enjoy. ... I have to say that the holidays attracted me. ... And I enjoyed science and I enjoyed particularly biology and I knew that I wanted to go to university. There was no pressure from my parents ...

In summary, Catherine became a teacher because she felt good about her own positive high school experience and very much enjoyed the school environment. Additionally the two-month summer holiday fitted with Catherine's lifestyle. Because Catherine enjoyed her science courses, especially biology, she chose science as her major.

What does Catherine like about high school students and what does she not enjoy about them? The following excerpts from interview data give us some clues:

I: Describe some desirable characteristics of a good student.

C: Doesn't have to be smart, ... Students who try.. who..by trying - personal unseen kind of trying - or it can be somebody who comes and asks you lots of questions and is very obviously working ..working hard. Friendliness. Kids who

seem to want to be there. ... So kids who seem to basically enjoy .. enjoy life ... I like courteousness. ... I don't mind kids that are talkative. ... Not because they are trying to create a disturbance but just because they are just generally bubbly, enthusiastic people and they just gotta talk to somebody. I think that is good and I think kids that are able to communicate freely with one another and that. That's .. I admire that characteristic. Although, I feel for kids that can't. That are very very shy even though they might be perfectly happy being that way but .. It's not a characteristic that I admire. Shyness.

I: What about some bad characteristics? Characteristics that illustrate a bad student for you.

C: I think students that are very wrapped up in themselves and have no time to see anybody else. ... I have not really come across a lot of bad .. Usually when you think of students' characteristics that you really don't like .. combatant type of students, although those are very rare. But there are some kids who have fought back. ...

Characteristics which Catherine values in students are characteristics that she appears to exemplify. She is an enthusiastic, friendly and courteous person. Her humour and hearty laugh often punctuate the interview tapes as well as interactions with students and colleagues. For example, in my field notes on September 25, I wrote:

In cafeteria free and easy conversation with student: Talked about coming baby with student and they made predictions whether it would be a boy or girl. Says, "Hi!" to kids in hallway. Talks to card sharks.

Chiding a student for telling another student the answer to a question, Catherine chose to use humour. In the field notes of the same day, I had noted how she dealt with the student in the following notation: "(name of student), you should get married. Just like a wife." Then Catherine noted how some wives tell their spouses what they should do and how they should do it. The students enjoyed the analogy.

Valuing students who wanted to be in the classroom, who enjoyed the situation and who tried very hard but were not necessarily strong students echoed the description that Catherine had given of herself as a high school student.

Catherine does not value shyness in students and considers getting a shy student to

open up and talk a real teaching success:

C: I think what I value the most is students being able to communicate. Even being shy individuals who never ask anything who you are never quite sure if they quite understand. Even if you question them, it's difficult to draw an answer. I think that when you see the kids are willing to give - to share - not only with you but with the rest of the class that is .. that is one of the things that I strive for. Sometimes it is so much easier to just lapse into the part when you are talking or writing and you don't really see what the kids.. what the kids are doing; what they're grasping. So I think I value the most is when I can get something back from them. When I can get them to share an idea. I know that they are thinking about something - everyone of them - if I could just draw that out of some of them. Especially the ones that are very shy. It is a very difficult thing to do. And when you are successful there, it is a REAL success.

And a little later in the interview

C: You can get the other kids to talk any time about anything. That's no problem. But it's the ones that have trouble, that are shy, that are just coming out. That's the ones that give me the greatest pleasure to teach.

Catherine does not value being self-centred and speaks of helping others as being a value:

C: It [her teaching job] fulfills me and myself being happy and useful, I guess, feeling that I am accomplishing something and that I am helping people to accomplish their goals.

People with tempers are disliked by Catherine and in this instance, Catherine is also describing a characteristic about herself that she does not like:

C: Sometimes I can become very angry. I do have a temper and that is one of the things that I don't like about myself. And one of the things that I am working on - to control this temper. There is no need to get upset about certain things.

The student is important to Catherine and she feels that she should be there to help if students require aid. This need to help students translates into conducting an informal class during the noon hour. She says:

C: ...You don't have virtually any time to give individual attention. I mean if you

give a few minutes of individual attention during class that is about as much as you can. So when students need extra help or need to finish something up the only time they can get that done or get the individual attention is during the noon time because that is a time when everybody is essentially at the school. Even after school people sometimes have appointments or have to catch a bus to go home. ...

Catherine repeatedly stresses the importance of dealing with personal things on an individual basis. For example, taken from the audio-taping of classroom interaction on September 24, the following conversation ensued:

C: Exam date has been set for Thursday October 1 on lessons 1, 2 and 3 - the whole unit. Multiple choice and written. It will take the whole period. I like to give you lots of advance warning in case there is any problem with that date. Anybody can think of anything right now?

S: I have surgery on that day.

C: That is a personal thing so you can talk to me about that after class, (name of student) and we will make arrangements for you. I'm thinking more of a social exam on that day, a math exam or something like that that would involve half a dozen or so. Try not to have more than one exam on that day.

She felt that students should discuss personal things with her and that the rest of the class should not be informed. She elaborates:

C: ... When a kid says to me "I can't come to the exam" or "I won't be here", I don't like to talk to them in front of the class because it is not their [the class's] concern. ... It's a personal thing and in a way ..why did you bring that up like during the class. How come you didn't tell me before or after class? So right away I tell them you can come and talk to me personally after class. This isn't something that we have to discuss and hold everybody else up listening to why you can't come and write the exam.

The last few minutes of most classes were left for talking to Catherine personally and usually several students took advantage of this time. Sometimes the talks extended well into the ten minute break between classes. On one occasion students from one of Catherine's other classes came to discuss personal affairs during the break.

Catherine feels that it is important to give students some adult privileges. For example:

I: ... And one of the things that I noticed is that you approved of the 30's having munchies in the class. And I would just like to know why you did that.

C: I approve of any grade - 10, 20 or 30 having munchies in class. I think that the time comes when you have to give them some adult privileges. And one of the adult privileges that I thought was really neat was to be able to take my coffee or whatever into the lab or lecture and like it was my responsibility to look after that. It wasn't such an authoritarian environment. And like I said as long as the kids respect the right to the next person to have a clean area to sit in, I don't mind that as long as it is not a disruption.

Thus, Catherine's vision of students includes ones who try but may not necessarily be academically inclined, friendly, courteous, and enthusiastic people who are able to communicate with others. She does not like selfish and combative students. She considers getting shy students to share ideas a real teaching success. She feels that personal affairs should be discussed with her individually. Finally, she feels that it is important to confer adult privileges to senior secondary school students.

Previously described were some valued characteristics of students but how did Catherine view the role of students? From her involvement of students in numerous laboratory exercises, field trips and homework assignments, it can be inferred that she expected active participation in the learning process on behalf of the students. To this extent her classroom exhibited student participation in the teaching-learning process. She thought that students should be able to think for themselves, research information and be able to communicate it. To this end she organized a significant assignment in Biology 30 where the students chose a disease that was associated with a body system, researched it - after receiving a library orientation session - and shared it orally when the class was discussing that aspect of the curriculum. She expected students to exhibit effort and to be the best that they can and she praised their efforts and prodded them to achieve more. She expected students to understand concepts and not just memorize facts. Realizing that students required a knowledge base before they could understand and apply

concepts and principles, Catherine lectured and presented audiovisual information which aided in providing that knowledge. Her examination questions were not just recall type of questions but included applications and interpretations. She expected the students to be interested and enthusiastic about biology and tried to infect them with her own enthusiasm and interest in the subject matter.

Catherine on Education, Biology and Biology Teaching

Catherine's Views on Education

Catherine believes that education should provide the means for students to become self-sufficient. Self-sufficiency is elaborated to include two aspects; education should teach learners how to acquire information and how to deal with one another. Another aspect of education for Catherine is communication.

High school, for Catherine is not the place for learning details but rather for learning a wide variety of subject matter. However it is important for students to know how to get that detailed information when they are ready. She says:

C: I believe that education should provide students with the means to become self-sufficient. Not just in being able to get a job, but in being able to acquire information, to be able to handle themselves in situations, to provide them with role models - not just teachers but to one another, to work, to do the best that they can. ... To take seriously that they are going to do something and let's try to make it an effort. I don't think that university, I mean, high school is for learning details. I know that my students won't remember the little things that I taught them and nor should they have to remember those things. But if they know how to go about getting it. ... And so from that I can see that a general program like the one that they want to introduce has a certain amount of appeal to me. That's the sort of thing that kids should be learning in school. ...

Catherine is consistent with her belief when she describes what she does in class:

C: Why not talk about the things that they want to talk about, curricular materials, and what you do have to cover. That is the kind of thing that is important to talk about and mention in class.

For example, in her Biology 10X class in a lesson discussing how light passes through the microscope and how the coloured image is perceived by the human eye the following digression occurred:

S#1: What happens when you are colour-blind?

C: OK. When you are colour-blind there are three different kinds of what are called receptors - light receptors - in the back. They are called cones. They are the ones that distinguish colour.

S#2: Why are they called cones?

C: Cones. They get the name, how do you think they get the name?... Cause they are shaped like cones. There are three different kinds of cones. Red, green and blue.

S#3: What about yellow?

C: Just red, green and blue. That's all. Red absorbs a certain wavelength of light. Green absorbs a certain wavelength and the blue absorbs a certain wavelength. And when you look at something, a certain object, wavelengths are reflected into your eye of a combination of those three. And your brain interpretes how many of the red cones, how many of the green cones and how many of the blue cones absorb light and are stimulated. And so the brain then mixes that information and you see that particular shade of blue or yellow or brown or whatever. Now in colour blindness one of those three types of cone is not functioning. In other words this is a genetic order which you inherit from parents. So if one of them is not functional it means that there is a different ratio of information and so some colours cannot be distinguished from others - a different colour. Red-green colour-blindness is the most common. Very few people are blue colour blind and it is mostly one sex. Mostly males. It is linked to sex. You will find out more about that in Biology 20 in genetics when we actually go into the genes that control colour blindness and how it is passed on and so on. Actually we spend a whole lesson talking about colour-blindness. It is very interesting. You can get sheets that will tell you whether you are colour blind.

S: So red and green look the same?

C: That's right. Red and green for example will look essentially the same. They look kinda greyish. And there are even different types within that so it depends.

S: When you get cataracts, can you tell me what part of the eye is affected?

C: It affects the lens. The lens is made up of protein and this protein kinda becomes very cloudy. Light does not pass through it very well. Light does not reach the retina of the eye so you have poor vision.

Although this optional material was not core curriculum content for grade ten biology, Catherine allowed part of the lesson to follow the students' interests. Observations from tapings of classroom interaction indicated that Catherine's lectures concentrated on important general topic areas. For example, Table 3 and 4, at the beginning of this chapter, show that Catherine discussed the historical development of the cell theory and the associated technological development that aided knowledge about cells on September 24 and the basis of taxonomic groupings on October 5 with the Biology 10X. With her Biology 30, she discussed cell organelles one day, the fluid mosaic model of cell membrane structure another day, the classes of organic compounds still another day. Each of these topics was a prescribed aspect of the curriculum. Her lectures were not excessively long and the lessons often contained a variety of activities. In response to my query as to why Catherine varied activities in her classes, she states:

C: I think to keep the kids and myself alert. It is just a variation on activities. I think that the same thing holds true for really young kids when you have an attention span of a few minutes and then you have got to go on to something else. ... Varying activities, doing a demo, showing a slide-tape presentation or having them do some reading in a little section or reading some handouts or preparing for a lab just keeps us all from becoming bored.

Later, Catherine elaborates further as to why she conducts her classes by using a variety of presentation strategies. She says:

C: I think this gives them a better chance to understand and see it presented three or four different ways by the teacher, by the book, by the film, by the slide-tape presentation, in the lab, the more different ways that you can present something the more, I think, the more .. the easier it is to retain.

Congruous with her belief that education should teach students how to acquire

information, Catherine works hard at not giving students answers, rather she guides them in such a way that the students acquire the information for themselves. She says:

C: ... I think part of the job is to teach them to think for themselves or if they are having trouble or at least supplemental to the actual thought or thinking through process and if they don't have the background information, that is pretty hard to do. But they can always find the background information and then do some more thinking about it and chances are they will come up with the answer and remember it so much more because they did it themselves than if you just told them the answer. ... I have let the kids struggle along a little bit and the more that they struggle the more hints that I give so eventually they can make some revelation by themselves even if it is a little tiny one because you have had to keep feeding them, hinting and guiding them along because eventually it will get better.

Catherine reinforced what she espoused by inviting a student to come into the laboratory at noon to view different kinds of paper under different magnifications. The expression of joy on the student's face when she viewed the differences was indeed pleasurable for the teacher. Catherine also refused to answer a question that pre-empted a laboratory exercise on the function of the microscope diaphragm by telling the student that he would discover the answer to his question in the laboratory the following day.

Catherine also believes that education should teach students how to communicate. There are several meanings that she attaches to the word "communicate". For example:

C: I think language is very important and students have to learn that what it is that they write down on paper can be interpreted in more than one way. I mean a whole...our whole...Laws for example, cases are won and lost for example, in court, based on just language that's there and the interpretation that it's time that they learned that if they mean something that they had better be sure that they put it down precisely in that way because I'm not going to try to guess that what I understand that they mean is actually what they meant. It can be interpreted in more than one way. And I think that high school is the place to start. Getting out of junior high mentality - as long as you just have the general kind of idea you don't have to worry about clarifying the thinking or making yourself clear. So as long as there is a...If I read a question and I feel that it is vague I don't...I feel it's vague, I don't know for sure what they meant, I'll give

them a part mark or no mark but not a full mark because I don't really understand that what I wanted was what they actually thought.

Catherine's actions substantiated what she said when one of her grade ten students questioned the marking on a set of questions that were returned. Only part marks were awarded when the language component was imprecise. Because Catherine values the role of models, she tries to be articulate and chooses her words carefully and "precisely". Another instance of Catherine's insistence on preciseness centred around the correct use of "towards one" or "toward one". The discussion ended with Catherine promising to check the correct usage with the English teachers and reporting her findings during the next class period which she did.

In summary, Catherine believes that education should allow learners to become self-sufficient by teaching them how to acquire information by finding answers to questions and discovering information for themselves in the laboratory. It should teach students how to work and be the best that they can. Education at the senior secondary school level should be general; the prescribed curriculum should be followed but the interests of students should also be accommodated. Catherine believes that presenting the subject matter in a variety of ways enhances its retention by learners. Education should teach learners how to communicate, not only orally with each other but also in written form.

Catherine Discusses Biology and Biology Teaching

For Catherine the most important idea or concept in biology was "how fantastic life is and that they [students] are a part of it". She expressed this idea in the following interview excerpt:

C: I think as I went through university, I just became more and more aware of how fantastic life is. What a fantastic thing! And if, as I now believe, - which came as a very slow process - that life was "spontaneously generated" I guess and developed over a period of time just made it even more fantastic to me. That there were so many different kinds of organisms. It just seems to me that it is such an exciting science compared to chemistry and physics! It just seems that it has so much more to offer because we ourselves are a part of that. Part of the life and so to try and get..That's why biology to me is so exciting and that's the heart of it - trying to get students to see how they are a part of this. How fantastic it all is.

In a later part of the interview, Catherine also states:

C: It [biology] is not sitting in a classroom and taking notes and seeing films and so on, I mean biology is a science and it is actively done. It is a lot like chemistry and physics but even more than chemistry and physics because a lot of that stuff is done in a lab but biology is more like getting out there and getting into the community or the ecosystem that you are interested in looking at and any time that you can have a field trip, the money is there, the time is there or it is a possibility then you have to try.

She goes on to elaborate on what she means by the wonder of life and the difficulty of trying to get students to appreciate this wonder:

I: Just the wonder of it all..

C: Yeah! Just the wonder! That's the word I was looking for. Exactly.

I: You scare me a little! Because I think that's one of my important things. To me that's what biology is about. Just the wonder that everything has a place and how it all fits together and if you disturb one part of it and - it can only be a small part - you disturb the whole fabric. You know the ripple..and to me that's what I would like to get across to my students too. It's just so wonderful and like you say chemistry and physics - oh my god!

C: It's OK but..and it is a huge task. You are so overwhelmed by it but you're overwhelmed because of the years and years of experience that you had, not only in school but personal experience. And it's just a monumental task in trying to pass that..

I: How do you go about in doing that?

C: Oh boy! Like I said..I think that it is just a very slow process and it just takes time and you're just one small part.

I: How do you do it, though? In your classroom? How do you start that process? If it has not already been started, how do you go about initiating that spark?

C: Well I think I look for certain situations with individuals. I don't know if you can do it en mass in a group because you are just dealing with too many separate

personalities that are in different places with regard with this wonder that you are trying to get across. And I look for individual situations where I can do that. For example, someone shows a fear of - Oh there is a bug crawling across - they had gone out and collected some leaves or something like that and there is a bug crawling across the table and somebody is afraid of it or somebody wants to squash it - I think those little situations are where you can start this. "You know that's not a green bug, look at it, it's fantastic!"

I: His mother thinks he's gorgeous!

C: That's right. This is where you start and your kids want to crush something or kill something, "Well geez! This is biology and we're here to learn about living things, admire them, not to destroy. That's not what we load the course with...to destroy, I mean, look at what you are doing. I mean the power that you have got over this little thing. ...Take a closer look at this little thing. Situations like that..

I: Like the pirhanas. Just before we came here.

C: Like the pirhanas. Try to get kids to look at them in a different light if they are looking at them in a light that is not favourable to the admiration of living things. I find the reproduction in the Biology 30 you know, it's great. I think that if they remember anything they're gonna remember that because they may never have ulcers or heart problems or anything like that but all of them are going to be involved in childbirth. So this is one. Also a perfect topic where you can get them to admire the miracle of development of life even though it is selfish in seeing it in our own children - but once they see that gee the way the human is in the reproductive process, development and birth and so on. It is so fantastic! How can they not help but apply it and say that lots of animals go through this and is it any less fantastic for a caterpillar or butterfly.

Expression of the wonder of biology and the importance of knowing that each person is a part of this wonder seems to take form for Catherine in specific instances such as the section on human reproduction in Biology 30 (which I did not observe) and specific instances that she encounters with her students such as the instance of a bug crawling across a table and students wanting to kill it or students tapping on the glass and teasing the pirhanas in an aquarium in the laboratory room.

Believing that biology is "not sitting in the classroom taking notes and seeing films" has significant implications for Catherine's teaching. Because her belief is that biology learning ought to be active and ought to be studied in situ, field trips become a very important part of her teaching repertoire. Although taking students on field trips entails a lot of effort and extra work, for Catherine, the work is worth the effort because

it satisfies one of her basic conceptions of biology. Catherine takes each of her classes on at least one field trip. She notes:

I would like to take more but were it not for finances and the fact that you take kids away from other classes for an entire day to go out on a field trip and then you incur the wrath of other people if you do this four or five times with the same class. That's really the only thing that holds back more field trips. Maybe a couple per semester for each class. Once you get a field trip, it is a lot of work, the worst is, of course, the meeting that you have done before when you are trying to get a feel for it yourself.

As shown previously, Catherine values getting along with other people, therefore she works within the constraints of the school setting, but keenly feels the displeasure that other teachers voice when classes other than biology are affected by field trips. To accommodate this constraint, she plans a limited number of field trips that will allow her to satisfy her belief that biology teaching should be on site and yet not "incur the wrath of other teachers".

Further, Catherine's belief that biology teaching ought to be hands on and active is supported by the 10 to 12 laboratory exercises in which she engages her Biology 30 students and the 8 to 10 laboratory exercises that she conducts with her Biology 10X students. The semester yields approximately 55 actual teaching days discounting various school-type interruptions such as assemblies. Discounting laboratory preparation time, actual time spent in the laboratory was approximately 18 percent of the time available. Doing laboratory work is aided at Catherine's school by a laboratory assistant and the consensus that all the biology teachers will do the same laboratory exercises. Catherine is also very cognizant of the laboratory work that is mandated by the Alberta biology curriculum, particularly the Biology 10. This is illustrated by the following:

I: At this school do all the teachers do the same labs? Or do you choose your own and others will do slightly different ones?

C: I think that we all do pretty much the same labs.

I: The same and the same number?

C: Very similar, very close or at least the Biology 30. The 30 teachers always get together and because these labs are so time-consuming to set up and because material has to be ordered in you really do have to plan for all of the teachers to do the lab and there really is no advantage I think, to having different labs selected by different teachers. First of all there aren't that many, well there are lots of different labs to do but you know there are the standard ones which pretty well everybody...everyone does and (name of laboratory aide), too, goes to a lot of trouble to set up the labs and they have been worked through and we have tried to modify and fix them up and so on. ... Most people at least who come in are very happy to do the same sorts of labs and then help us to make any changes that are necessary. You don't really get very many people that are interested in, at — that I found, that want to do totally their own thing that don't want to do necessarily the same labs as another. Plus you are controlled to some degree for example in Biology 10 you have to do dissections - the earthworm dissection, the crayfish and the frog - so there are the mandatory type labs that you feel that you should do because it is directed by the curriculum.

Catherine uses the laboratory exercises to reinforce the work that has been done in the classroom. She expands in the following interview excerpt:

I: ... Why do you do labs?

C: Well I think it.. We try to get the labs to reinforce what has been done in the classroom or to introduce material usually what is happening is we do it not to introduce concepts so much as to reinforce concepts that they are already aware of. So of course to supplement the material in the curriculum, good hands-on ... I think the kids enjoy ... enjoy actually working with the chemicals, the organs that we are talking about. I know that a lot of them are apprehensive at first or at least they let you believe that they are apprehensive at first and that they don't enjoy it but most of them go out of the lab very up.. very happy about what has been accomplished and so.. It's a nice break too, gets you out from the front of the class and gets them doing something and actively participating instead of listening to someone discussing. ...

The laboratory exercises also provide an arena for students to work together. This puts into practice one of Catherine's beliefs: that education should provide the means for students to learn how to deal with one another. She discusses a particular Biology 30 laboratory instance where two students confused two reagents:

I: ... You have chosen most of your labs so that it's pretty well guaranteed that they will give good results?

C: Not initially! Lots of things go wrong. At this point we have tried to refine the labs so that at least you get fairly reliable results.. at least some part.. you have some success in some part of the lab. You can see yourself in the last part of the last lab.. mistakes will be made. Kids will put the wrong solution in and so on. You can't guarantee success really in a lab. You can just set it up so that things are straightforward so that there is a good chance that things are going to work out right for the students especially if you are going to take the lab in and you are going to mark them on.. you are looking at their results to indicate how well they have done the lab, did they understand what they were doing and have they set things up properly and I would feel that it's not fair to mark them on that basis if the lab isn't well organized and can't be guaranteed of some.. that the chemicals don't work properly that there isn't any contamination right away to start with and so on. Well this lab.. I think the biochemistry labs are the worst ones for things going wrong because there are just so many variables and you have to keep on working with another group's test tubes from the previous lab and with their washing techniques ... Their whole lab skills come into play and lots of things can still go wrong.

I: If anything can go wrong it will!

C: Just adding that Biuret solution instead of Benedict's. I mean what more can you do except stand over the student and say "No, no, no this is the stuff that you add. Not that. This!"

I: I had watched them! They had both bottles. Gee is there any difference and they looked at them. No, I guess not. And then they went ahead and I thought OK just let them do their thing!

C: I told my next class. I mean I had warned them about it. I thought well I'll try and prevent another group from doing that and we had a good laugh about it. You know, I said, "Look at this - Benedict's and Biuret. You know they both start with a "B" but that's about all that is the same between those two words. And mind you the Biuret is just a little bit blue so you could get confused with Benedict's I suppose". But it brought up about reading labels and it was a learning experience. Especially for those kids that did it and they wanted to go over and look at somebody else's results.

I: What did you do?

C: I said, No! No! you made the mistake and go over. The girl tried to blame the guy that he put it in. Here's another opportunity - Partners working together! It is not one person's fault or the other person's fault, they are both responsible for the labs. Just do it again. Just to reinforce the idea that it is Benedict's that you are supposed to be adding and not Biuret. There is lots of opportunity when mistakes are made to correct them and to learn from them.

In summary, Catherine believes that the learning of biology ought to be an active involvement of the student with the subject matter. Therefore she makes every effort to

involve each of her classes in at least one field trip. During the observation period, Catherine took her Biology 10X students on a taxonomy linked field trip to the zoo and was in the process of planning a Biology 30 field trip connected to the blood and circulation unit. She reinforces the learning of subject matter with laboratory exercises. By having the students work in small groups, Catherine also reinforces her belief that students should learn how to communicate and work with each other.

Catherine's Typical Routines and Strategies on Laboratory Days

Catherine's teaching days can be divided into several categories: examination days, field trip days, laboratory days and non-laboratory days. One of two formats was used to initiate laboratory days. Because the laboratory was a physically different room than the classroom Catherine taught in, a change of rooms was necessary. Some days, Catherine would ask the students to move to the laboratory and then addressed the routine house-keeping chores such as attendance, reminders about examinations or the need to hand in forms or exercises - as well as giving final instructions in preparation for doing the laboratory exercise. Other days the routine jobs were addressed in the classroom and then the students moved to the laboratory room and began their laboratory exercises directly. For example on September 24th Catherine introduced the identification of lipids and proteins laboratory in the classroom in the following way:

C: ... Just take a little bit of the lipid and rub it into the paper really well. Then let it sit and then scrape off the excess. Put all the samples on one sheet and then hold them all up to the light at once. Awright. Then you are checking for translucence. In your Sudan IV, add a little bit of Sudan IV powder on a tooth pick into the sample. Stir it up really well. You should be able to note a really nice bright pink colour with the Sudan IV dye dissolved in the lipid portions - lipid soluble - of any compounds containing lipids. It may be that a portion of the compound may be lipid but not the whole thing. That is why you need to mix it up

really well and look for areas where the dye is dissolved. It is soluble in lipid. It is not soluble in water. The protein test - the Biuret test - the one that you will be doing. Try the peanut butter on a spot plate. It is pretty hard to put the peanut butter down a test tube add the Biuret and so on. So if you put it on a spot plate, add the little bit of Biuret and again take a fresh toothpick mix it up really really well. Each of your samples that you are mixing with Sudan IV by the way should have a separate toothpick That is to prevent contamination in the transfer of material from one sample to another. So mix it up really really well and then look for this colour change. You may just want to put a little bit of the Biuret on a separate section of the spot plate so that you can compare and see if anything has happened to the Biuret solutions in terms of the colour change. The rest you can do in the test tubes themselves. Ah.. I will set up the samples with the Millon's tests and you can have a look at the results when you have finished the tests... As I mentioned yesterday these are being done as demos because the, for example, the Millon's test has a strong acid and having a strong acid on all of the benches is a little bit risky if it does get spilled. Millon's also contains mercury a toxic substance which can be absorbed by your skin. Some of the chemicals are toxic and that is why these are done as demos. Now are there any questions? .. Now the questions that are done at the end of the lab, I don't like them. So what I am going to do is I am going to put some alternative questions on the board and when you get back from the lab you can write them. I like the questions to have .. to help you interpret the data or to point out something that you have learned from the lab, focus on something that you have done. These questions are too general and they don't necessarily relate to the labs. OK. Same format as always. Aprons on. Work in groups of two and get yourself organized.

The students proceeded to the laboratory room next door while Catherine quickly began to write the new laboratory questions on the chalkboard.

Usually typical instructions included the formation of groups, the number of questions and/or diagrams that needed to be completed, the due-date for handing in the exercise and an explanation of where materials necessary to do the laboratory exercise were located. Reminders included dates of up-coming quizzes or examinations and the need to hand in certain forms. While the students carried out the laboratory exercise, Catherine circulated throughout the laboratory, answered any student queries, learned names of students she did not know (during the first few periods only), pointed out what students had to do, praised efforts, and encouraged their work. As new points arose or as it became evident that the whole class needed certain pieces of information, Catherine

addressed the class. For example during the Biology 10X microscope laboratory, she interrupted in the following way:

C: I should perhaps just draw your attention to the broken glass container. It usually sits up on the centre island here. If you break a slide or coverslip there is nothing wrong with that. It happens all the time. Accidents happen. If you could take up the pieces - there is a dust pan and broom up at the front - take up the pieces and put them in the broken glass container. Do not put them in the garbage along with the papers and paper towels. Broken glass can be very dangerous if something happens when emptying the garbage.

A little later during the laboratory several students asked how to use the formula for determining the diameter of the high power field of view. Catherine asked for the class's attention and explained the use of the formula to everyone. About five minutes before the end of class, Catherine reminded students that she wanted the microscopes correctly put away and expected the exercise questions to be handed in at the end of the laboratory period.

Thus on a laboratory day, Catherine typically introduced the period's lesson either in the classroom or laboratory room and devoted the remainder of the class to the laboratory exercise. While the students were involved in the exercise, Catherine circulated among the students, gave individual help, praised efforts and generally facilitated the smooth execution of the exercise.

Catherine's Typical Routines and Strategies on Non-laboratory Days

Utilizing either a homework assignment, a diagram, a previously seen slide-tape presentation, or a laboratory exercise as a springboard for further discussion, Catherine often interacted with students using student answers to begin an explanation

such as the function of the microscope lens system, the relationship between magnification and size of field of view of the microscope, the function of cell organelles, the synthesis and function of proteins and so on. Catherine often showed slide-tape presentations (Two were shown in Biology 10X and five were shown in Biology 30 during the observation period.) that took the place of her lecturing or explaining aspects of the course. As illustrated earlier, she felt that if students were given multiple ways of explaining a particular concept, the students would retain it better. Seeing pictures and reinforcing these with an audio-presentation were seen as being useful ways of reinforcing this. When Catherine lectured or explained concepts, she liked to draw pictures on the board that she thought would enhance student understanding of what she was presenting. She explains:

I: You do a lot of explaining using diagrams or some sort of a visual such as a box diagram or a linear type of diagram. Do you know why you do that?

C: Well, I think that the more means that you have to help the student to see what it is that you are talking about is really important because a lot of kids just don't pick up on the verbal. I know there are other methods of illustrating a point besides those two but I think in biology these are the primary methods and you have a handle on things on what you do in the lab as well. Like the blood pressure stuff we are doing today. I mean what better way to talk about blood pressure and illustrate the concept than having the kids actually doing it? So I think it is just that I feel that it gives an extra reinforcement - it reinforces what you say - if you have a diagram to look at. Diagrams usually have to be simplified and the saying that a "picture is worth a thousand words" - I really believe that.

Analogies were also used in her explanations. For example, the following analogy was used to illustrate the enormous number of different proteins that can be synthesized:

S: Could we please look at Objective # 27? (This objective reads, "State the four reasons for the extreme diversity of protein molecules.")

C: Diversity means so many different kinds. How is it possible to have such a variety of proteins? Can you think of some of the reasons why there is such a variety?

S: The order of the amino acids.

C: Sequence of amino acids. You've got virtually an unlimited combination of possible amino acids that could be linked together. Just like remember the number of phone numbers - seven digits and how many phone numbers you could get?

S: We didn't do that.

C: Did you do that?

S: No!

C: We didn't do that? Alright! I'll show you that example. Alright seven digits in a phone number. Now..How many possible choices do you have for numbers that could go in the first digit or first position?

S: Nine

S: Ten

C: Now some say 9 and some 10. Hypothetically how many?

S: Ten

C: Ten. Zero, one, two, three, four, five, six, seven, eight, nine. That's ten different numbers. Hypothetically we can say that a phone number could start with a one or a zero. So we have ten different numbers that could occupy the first position. How many different numbers could occupy the second position?

S: (in unison) Ten

C: The third position?

S: (in unison) Ten.

C: Alright. How many different possible phone numbers can one get using seven digits with ten different numbers in any one of those seven positions? Just based on this system how many different phone numbers can there be?

S: Ten million

C: You get it by 10^7 . $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$ or ten million different telephone number combinations. That is just based on just seven digits. Now how long is a protein? Let us say that the shortest protein has approximately 100 amino acids long. That means we now have 100 little spaces to fill in instead of seven. Obviously I'm not going to put them all up here. Right? How many amino acids could occupy the first space?

S: 20

C: 20. There are 20 different amino acids. You have your choice of any one of those 20. How many can occupy the second space?

S: 20

C: Any one of 20 and the third space and so on. Your shortest protein of 100 amino acids long - how many different possible proteins could be manufactured?

S: 20 100

C: 20 100. Now that's a lot. Now what happens if your protein is a 101 amino acids long? 102 amino acids long? 500 amino acids long? 1000 amino acids long? How many different proteins can you make?

S: A lot!

C: Sky's the limit! Proteins are an extremely diverse group.

Catherine also liked to use demonstrations of apparatus. To enhance what she was talking about she showed three types of microscopes and passed around the iris diaphragm

during the introductory explanations of the microscope. She often used handouts to talk about certain things:

I: Why do you like using a lot of handouts?

C: Well I don't think that the textbook is perfect in that it doesn't supply a lot of the visual material. I like some of the handouts explain things or allow the students to see the concepts much better than the diagrams in the textbook. Some of them seem more accurate and/or simpler - not quite as complex. And some of the handouts are just not in the textbook. And it is one thing to flip on a transparency but it is not going to be much value to the student when they are studying for their exam to try to remember a transparency that they saw.

I: And if they don't reproduce it accurately..

C: That's right. And you spend a lot of time reproducing it when you don't want the kid to spend the time sitting there reproducing it. You want the student to spend the time looking at it and understanding it and listening to an explanation or giving an explanation and not drawing down the boxes or drawing the diagram of the heart although I mean that would help. I think that when it really comes down to learning it, sometimes you have to try drawing out the diagram yourself. The heart for example.

I: Maybe that's what the students would do in their studying.

C: That's what I would expect them to do there and not spend that time in class because the time in class is so precious that you.. any way that you can condense that time down in order to help get through the concepts..or at least to help just introduce the concepts and then let them try to internalize, grasp the fine detail later on..and have this same stuff that they had in class seems to help and try and remember this stuff. To really truly remember what really happened in class I think that you have to look at it very shortly after the class and most of them won't do that. It will be several days or two weeks that they will review that material.

Although Catherine had multiple handouts she took the time to distribute each one separately, discuss it and distribute the next one, discuss it, and so on. Catherine explained that this methodology prevented loss of handouts by students, minimized wasted time while students searched for the handout and prevented disturbances of the discussion by the snapping of binders while students retrieved the appropriate handout. This pattern was adhered to for all the classes that I observed.

Therefore non-laboratory days were characterized by discussions of curriculum topics presented in several ways such as slide-tapes, films, handouts, analogies,

demonstrations, and verbal explanations accompanied by diagrams on the chalkboard. Catherine involved her students in the discussions by asking direct questions or using questions from readings, labelling of diagrams or exercises assigned for homework.

Classroom Management by Catherine

The smooth functioning of a classroom is facilitated by maintenance of some form of order and control. Catherine's classes were not marked by a great deal of disruptive behavior. We discussed this aspect of teaching in the following way:

I: How do you maintain your authority? Say within your department? and in class?

C: Well I suppose that and I'm getting better at this and that is speaking up. As something happens that you're not happy with and you feel that you have been infringed upon... I think that the speaking up comes easier when you know somebody fairly well. For example, (name of teacher and name of teacher) and that.. I am quite comfortable with them now and I am not afraid if that's the right word to use... Of what they will think of me if I tell them I don't think that this was handled quite correctly. Or I don't think that this is fair or that this is right. I think that as you work more together you feel freer to do that. I think that initially it's very... it's difficult to do that. At least I find it that way. Someone like (name of teacher) might not find it that way. At least I don't think that she does because she comes in quite easily and makes sure that things are being done appropriately. She has no problem maintaining even grasping authority right initially. Whereas I'm not.. I don't come on quite that strong at the beginning but as I get to know people and so on then I'm less reluctant to express my point of view. As I get older too you think about when you were younger and you're and - you always felt that everybody knew more than you anyway - so you'd listen and you'd learn and so on. After a while you realize that geez just cause they're older doesn't mean that they do things better. ... Of course I haven't been to another department for awhile. ...

I: How about within the classroom? With your students, how do you maintain your authority?

C: Well I think that by starting right at the very beginning. I don't believe in being lax at the beginning and then trying to assert some authority in the end. I'm a firm believer in asserting authority right at the beginning and that is when

you really have the students too. Because they are in a brand new situation. Some of them may not know anybody else in that classroom, very infrequently do you get a class where everybody knows everybody. ... and they are really interested in the beginning in doing well. And I think I do that first of all by volume of my voice. Sometimes Scott says "Geez, you're shouting at your kids again!" He can hear me through the walls. But there is something about voice. If you speak very quietly you are going to lose them right away. First of all because they can't hear you and like the acoustics in the classrooms are very very bad so I just talk loudly because I want everybody to be able to hear me. There is nothing worse than listening to somebody that you can't understand because you can't hear them. So I think that voice is one thing and that projects to them that I'm not afraid to speak up and even you guys at the back are going to have to listen because you can't help but listen. ... I think the way that you carry yourself too. And that you are not afraid to move into the class like you are not glued to the blackboard in the front but that you actually will move towards the middle or towards the back of the classroom while you're talking. I try to do that every once in a while. ... And just letting them know right at the beginning of the first class where I stand as far as attendance and so on goes and giving little reminders every now and then. The key is not to slack off.

I: To be consistent?

C: To be consistent. If you are asking kids to be on time and they should be on time all of the time and not just be on time at the beginning of the semester.

I: And you yourself should be on time?

C: That's right.

I: I noticed that you are on time.

C: Well I try but again there are times when ten minutes when talking to a student is not enough and you are wanted on the phone and then an administrator wants to talk to you and somebody else asks a question and you are not on time. And so I am not really rigid in enforcing that but I do let people know that if you have a chronic problem you are a chronic late that is what I am concerned about. So in trying to enforce rules and trying to set some example yourself. You're ready to go.

I: Once you establish this authority, how do you enhance it?

C: I guess by carrying through. Once you have threatened to do a thing if they don't. For example if kids are late chronically I actually remove them from the class. Having them go down to the office and report to the administrator because they are late. Other kids see that or hear about it and recognize that you do run the classroom.

And later

I: ... Teachers are being described as gatekeeper, because you have the power - the authority - to fail or to pass a student. ... How do you feel about this function? Are you comfortable with it?

C: I don't feel that I have as much authority as I think I do. When it comes down to the marks you have got a kid with a 47 or a 48 percent like they have been borderline the whole ... I just don't feel that I have that much control over their marks. ...

I: Well, what do you do with a 48?

C: I round it up to a 50.

I: Give them a chance?

C: That's what I am instructed to do.

I: Oh yeah.

C: There is a policy within the school where if a student has a 48 or a 49 and is a credit-no credit/pass-fail situation or another one is the honours category -- 78 or 79. That one I have a little bit of trouble with because I wonder if an honours student really has 78s or 79s whether he really is an honours student or is just a very good B student. But with the 48s and 49s I just feel that the pass/fail thing is just too significant. I usually do tend to round 78s and 79s up because it is also school policy but I don't. I would just as soon leave it at 78 or 79. So I don't think that I have a big power. A lot of it is being told what to do there and anything below that there isn't much that you can do about that. There are the marks right there in black and white.

I: And usually you have rounded up every mark anyway.

C: That's right. Well our computer sure does. We put them in and it converts it to a percentage and it always goes up to the next higher percent and so that's why too when kids come to you and want to argue about half a mark or one mark I say "Save your breath. You are talking about half a mark out of a thousand marks that you will get in this course." It is really insignificant to start adding the pluses and minuses because your mark probably won't vary. Maybe one percent tops.

In summary, classroom management is maintained by the use of voice, bearing, moving among students and informing students about policies. Consistency in dealing with students and carrying through stated consequences of aberrant behaviour help to minimize disruptive behaviour. Catherine's tight organization minimizes the opportunities for discipline problems to arise in the first place.

Catherine's Introductory Lessons

Introduction to Biology 10X

My observations of Catherine began in September on the first day of classes.

During the introductory classes Catherine established many routines and ways of carrying out activities, shared values and communicated her expectations of students and what she felt was educationally vital. The following section outlines the occurrences during the first meeting of Catherine and her Biology 10X and Biology 30 students. The first class to be observed was a group of grade ten students. As the students entered the classroom and found a chair to sit in they appeared tentative and unsure of themselves. One could feel the undercurrent of excitement mixed with fear of unknown procedures and expectations of, not only the teacher and course, but also those of a large high school. While Catherine readied herself for her first encounter with her Biology 10X students by checking her notes and handouts on a side table, a displayed overhead directed students to read several pages in their textbook, make notes on several objectives in the first unit and to label a diagram of a microscope in their unit. There was little student-teacher interaction except to ask where students could sit. Catherine had placed her name in bold letters on the blackboard.

When the buzzer sounded, Catherine began her introductory class by telling the students her name, outlining the two-semester nature of the class, that the students would write a final examination in January and that they would begin Biology 20X after that. She would be their teacher until Christmas at which time she would begin her maternity leave and another teacher would be taking her place. She introduced me as a graduate student at the university who was doing my thesis research. She asked me to explain my research which I did. At this time I also explained the importance of the release forms and distributed them with the plea to return the signed forms as soon as possible.

Continuing with her agenda, Catherine described her desire to know student

names and circulated a seating plan. She asked students to fill in their names in the appropriate spots with pencil so that moves could easily be altered if students changed places. Introducing the university-level textbook, Catherine noted that the International Baccalaureate students would utilize this book for their three courses in biology and could rent it or purchase it if they so desired from the biology office by speaking to Catherine later. Combining the distribution of textbooks with checking of the classlist, Catherine called the names on the list and the students came up to her desk one by one and received a text. Catherine responded with a "You're welcome!" to every student that thanked her for the book. At the same time students were asked to correct the pronunciation of names and to inform Catherine if they used preferred names that were different from their official names. Catherine began to use names almost immediately after the seating plan was returned. Catherine also made the students aware of a dictionary of biology which she recommended and was available for purchase from the science department. Course outlines for the topic areas were distributed and students were asked to alter the dates as the ones that were there were those of the previous year. Because the course had not changed and Catherine did not like to throw away handouts, she used what was left from the previous semester. She briefly elaborated on each topic area and engaged students by asking simple questions such as "What is diversity?" She mentioned that the survey of organisms section of the course would be enhanced by numerous dissections. When a student asked whether dissections were mandatory, Catherine talked about the idea that many students had reservations but went on to like the dissection part of the laboratory work. The following excerpt from the classroom interaction illustrates part of the exchange:

S: Will we be doing cats and dogs?

C: No. We will not be doing cats and dogs. We have no place to keep dogs and cats! Maybe if you go to veterinary school they will let you do dogs and cats. Basically we stay with the small animals that you can accomplish in the time that you have... Once you become involved in it you are not looking at the whole but at a part. You will soon forget about the whole organism. I had the same problems that you have but after doing three years of biology and then going to university into zoology courses your mind changes... A lot of people are squeamish but after they get going they are not affected... Any other concerns like that? Let me know if you really find it a problem. If you are the kind of person that faints, I call that a problem with dissection. So let me know. OK?

Catherine then proceeded to talk about her evaluation methodology for the course. She cautioned the students about keeping their laboratory work in a special binder because periodic external evaluations of the laboratory work are requested by the examination office of the International Baccalaureate program. She also noted that students know laboratory dates in advance, that they are always given a handout prior to the laboratory, and that they must be well prepared before doing laboratory work. Catherine then handed out a sheet that outlined the course objectives and evaluation. The flip side provided a schema which students could use to help them track their own grades. Discussion on each of the objectives ensued. Catherine likened biology to the learning of a foreign language and told students that she expected them to know the meaning, pronunciation and spelling of biological terms. She then continued to review the percentage values assigned for each topic area. Catherine brought attention to the quizzes which were worth 5% and that there would be two to five of them interspersed throughout the year. She also noted that the students would do six to eight laboratory exercises. Stressing the importance of students keeping a record of their marks, Catherine showed how the schema could be used to help organize this task for them. A course information and regulation handout was distributed and Catherine discussed and

elaborated information on each point. For example, she elaborated on point four which states:

Students missing exams may write a make-up exam provided that a phone call was received the day of the exam. If a student fails to attend the make-up exam, he/she will be assigned a mark of zero. Make-up exams are scheduled to be held the last Tuesday of each month at 11:35 in room 110.

She pointed out that the questions on make-up exams were all written response and not multiple choice questions. Later in the semester, this point became important when Catherine dealt with a student who challenged her on the fairness of administering a written make-up examination. Several questions were posed by students and Catherine answered each one. After going over all the points on the handout, Catherine asked whether there were any questions or other clarifications. After every major section of her introduction, she asked the students this. This pattern became obvious in all later lessons. Catherine allowed for exceptions to the set-out rules by noting that she treated the students as individuals and that there were alternatives to the rules but they had to be dealt with individually. Next, Catherine handed out the first unit. Before she could talk about the unit, the buzzer signified the end of the class. Catherine, who had previously prepared and displayed an assignment on the overhead, displayed it again and asked the students to do it for homework. She then dismissed them by saying, "I'll see you on Tuesday."

On the following day, Catherine continued with an elaboration of the unit and its subparts. She also explained that the units were constantly being revised and that other texts could be signed out on an overnight loan. Catherine explained that due to the overcrowding in the school cafeteria, her classroom would be available as a lunchroom for her students and that students could view course-related biology films while having

lunch. Advertisement of audio-visual presentations would be posted on the chalkboard at the beginning of the week.

Catherine cautioned that readings in the textbook were a student responsibility, "should be done regularly and that there was minimum class time for this. She stressed the importance of being prepared for the next class or the students would be "left behind in the dust". This completed Catherine's introduction and she turned immediately to a discussion on the development of the microscope. She demonstrated by using a hand lens and three different microscopes including the monocular and binocular light microscopes and the stereoscopic dissection microscope. Pieces of information that Catherine thought were important were written on the board. She gave hints about what was important for students to know. For example she noted, "I don't expect you to know all these dates." Student-directed questions required one-word or short-phrase answers. Catherine then asked the students to turn to the diagram in the unit. The labelling of this diagram had been assigned for homework on the introductory day. Using the seating plan that the students completed the previous day, Catherine asked individuals to identify the parts of the microscope. The following exchange is an example:

C: What do you use that part for?

S: To look through.

C: To look through. First of all, this is the part that you look through. Right? Now it also has a number on it. What's that number?

S: Ten

C: 10X. What do you suppose that means?

S: That it magnifies 10 times.

C: Very good. It has a lens in it and it magnifies 10 times. Alright, the second structure, what is that? Cheryl?

Cheryl: Does that mean that the ocular always magnifies 10 times?

C: No. Absolutely not. In our microscopes it is 10X. For example you can get different microscopes and it will vary. For example on this microscope...no these are all 10X but you can get different microscopes and it will vary.

Cheryl: What is the best magnification on the ocular?

C: I can't actually give you the best magnification on the ocular but 10, 15, 20

times are all used...

A short discussion on total magnification of the microscope followed between Cheryl and Catherine. Catherine then reiterated her original question as to the name of the structure that the second label line was pointing to. Using her seating plan, she asked James:

James: Body tube

C: What is the function that the body tube does?

James: It is the space between the lenses.

C: Good. It is the space between the lenses. The lens down here and the one on top. It supports the ocular. OK. The third structure..

Catherine continued this methodology each time asking a student, repeating the student response and elaborating on the function if she felt that it was necessary. This strategy, which Catherine established on the second day of classes, was evident in subsequent classes in both Biology 10X and Biology 30.

She elaborated on the function of the microscope diaphragm and passed around an iris diaphragm for students to view. She then compared a disc and iris diaphragm. Usually Catherine would ask whether there were any questions and the following ensued:

S: Why would you want to have just a little bit of light instead of a big amount?

C: How about if I let you discover that in the lab? OK? That's one of the things that we will be looking at in the lab. Why is it important to control the light? Does it make any difference to the specimen that you are looking at? You will discover that for yourself in the lab. Anything else? Finally at the bottom...

This dialogue with the student confirmed in action what Catherine espoused when she said she valued having students discover information for themselves.

After completing the checking of the labelling and discussing the function of each microscope part as well as the care of the microscope, Catherine referred the students to an appendix in a handout of the unit and discussed each step of setting up the microscope,

cleaning the various parts, focussing and putting the microscope away. As she did when reviewing the microscope parts she prompted students to explain what to do next and why. She used the microscope to illustrate each step of the discussion. Lastly, she asked the students to review each part in their mind. She then told the students that she would be away the next day and she wanted the students to read the laboratory exercise and to highlight the procedure. Catherine noted that it was very important for them to be organized. This comment foreshadowed Catherine's need for organization as outlined in the description of Catherine as a person.

Introduction to Biology 30

Catherine's Biology 30 introductory class followed a similar routine to the Biology 10X although the atmosphere at the beginning of the class was more relaxed. Although there was a sense of anticipation by the students, there was also a feeling of "I-know-the-ropes". Before the initial buzzer sounded, there was casual banter between Catherine and the students. Some students posed questions about the pending oral report on diseases. Students and the teacher already knew each other from previous classes and extracurricular activities as shown by their use of names. Catherine began by stressing that all students required a grade of 50% in Biology 20 before they could continue with Biology 30. If students did not have this passing grade, they should alter their timetables as Catherine would be checking all grades and students would be asked to leave if they did not have a satisfactory grade in the prerequisite course. As in the Biology 10X, she told the students that she would begin her maternity leave at Christmas, but this time she shared more information with the students in a humorous way. For

example, she noted that the baby was due on the tenth of January and that if she did not initiate her leave at Christmas she would have the baby right here on the spot. As in the Biology 10X introduction she addressed the checking of the classlist, distribution of textbooks, making of a seating plan, advertised the dictionary of biology, outlined the course topics, discussed the course objectives, evaluation and regulations. As she discussed each section she handed out an appropriate handout which was similar to Biology 10X but adjusted to the Biology 30. She then addressed the "disease research assignment" which the students had asked about prior to the beginning of class and supported her discussion with a handout. The buzzer interrupted and Catherine signified the end of the class by asking the students to choose their topic by Friday.

Summary of Findings about Catherine

Aspects of Catherine's functional paradigm which were revealed in the interviews, classroom interaction audio-tapes and field notes are summarized in Figure 2. Catherine's scholastic background included a four year science degree with a specialization in zoology plus a certificate in education. She is married, has one child and is currently pregnant with her second child. By choice, she teaches part-time (three courses) and spends the remainder of her day taking care of her child. She is well-known to her colleagues, pilots curricular materials for authors and is an author of some curriculum materials herself. She describes herself as anxious, sensitive, gentle, and favours getting along with people. She says that she has a temper although this is not evident. She is observed to be self-confident, knowledgeable, and an authority on biological concerns. She is organized and directs a disciplined classroom. She prides

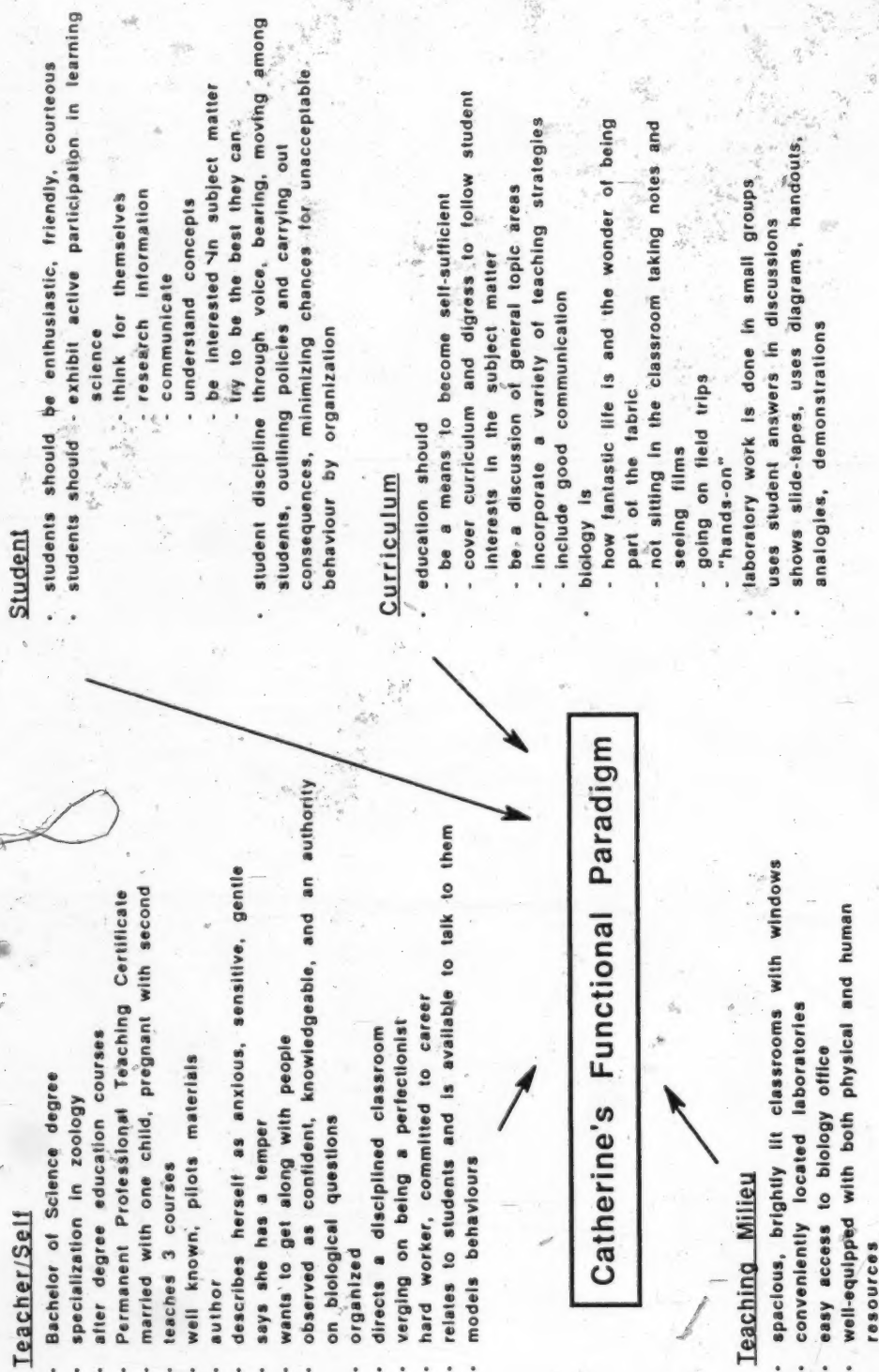


Figure 2. Aspects of Catherine's functional paradigm

herself on doing "better than good" work and is committed to her career. She would like to relate to students and is available to talk to them. Catherine models behaviours that she would like students to emulate.

Catherine's classroom setting is spacious, well-lit and has a lot of natural light. Convenient access to the laboratory room enables a smooth transition from classroom to laboratory. The school appears to be well-equipped and has an aide to assist in laboratory preparation.

Catherine thinks students should be enthusiastic, friendly and courteous. They should:

1. exhibit active participation in learning science,
2. learn to think for themselves,
3. research information and learn how to communicate it in written and oral form,
4. understand concepts rather than memorize information,
5. exemplify interest in the subject matter and
6. try to be the best that they can.

Catherine does not like selfish people. She maintains student discipline through the use of her voice, her presentation of herself (bearing), by moving among the students, clearly outlining policies and rules and subsequent consequences of breaking these, and consistently carrying through with the consequences. Catherine minimizes discipline problems by her organization of classtime.

Catherine thinks education should be a means for becoming self-sufficient, that is, the student should learn how to access information and how to communicate it. She thinks that it is vital to cover the general prescribed curriculum topics but allows

digressions in subject content to accommodate student interests in the subject. She incorporates a variety of teaching strategies (discussion, handouts, slide-tape presentations, analogies, laboratory work) to teach the curriculum. Biology is a special discipline which exemplifies "how fantastic life is" and the "wonder of being a part of its fabric". Catherine describes biology as "not sitting in the classroom, taking notes and seeing films" but rather as a science that studies plants and animals in their surroundings. It is a hands-on and active science. Catherine takes each of her classes on at least one field trip and performs in excess of eight laboratory exercises with each class. She shows at least seven slide-tape presentations during the observation period and uses numerous handouts to supplement her discussions.

Catherine heralds many aspects of her functional paradigm to the students during her introductory classes. Although she does not discuss her scholastic background, she appears knowledgeable, confident and organized. She presents an outline of the course content complete with projected dates; she outlines policies and rules with subsequent consequences if they are not adhered to; she models expected behaviours by being on time and by being prepared for the day's class; she shows her concern for the student by getting to know correct pronunciations of student names and by inviting them to use her classroom as a lunchroom due to overcrowding in the cafeteria. Catherine involves the students in her first discussions signalling to them that this is part of her methodology and she uses a variety of strategies in her introductions (four handouts, the chalkboard, a demonstration of microscopes) that foreshadows a multiplicity of techniques in subsequent classes. She stops and wonders if the students have questions at the end of a major section and follows this pattern throughout the observation period. She warns the students that they should be organized and tells them that she likes organization. She

usually concludes the lesson a few minutes before the buzzer signals the end of the class and allows a little time for students to discuss personal concerns with her. This pattern was established throughout the observation period.

Introduction to The Second Case Study

This section is concerned with the findings about Tom. Tom's immediate teaching environment, consisting of his combined classroom-laboratory, is described first followed by an introduction to Tom as a person. A description of Tom's views of students and a vignette of his school's milieu is followed by Tom's views on education, biology and biology teaching. Because Tom's routines are not as clearly divided into laboratory and non-laboratory days as Catherine's are, an outline of Tom's routines in general is described and is followed by a segment on classroom management. The findings about Tom are concluded by presenting a vignette of Tom's introductory lessons during the first day of the semester. Tables 5 and 6 outline the instructional sequence in the Biology 20 and Biology 30 classes during the observation period.

Table 5

Outline of Tom's Biology 20 Classes

September 9	Introduction to Biology 20
October 20	Discussion of genetic test crosses Students working on worksheets of dihybrid crosses and checking answers individually with teacher
October 22	Students continue work on genetic problems Discussion of gene interaction and sample problems

October 23	Students put gene interaction Punnett Squares on blackboard Students check their work Tom introduces sex linkage Students work on sex-linked genetic problems
October 27	Teacher absent Genetics examination
October 29	Returned marked examinations Discussion of DNA
November 2	Discussed computation of report card marks and discussed each mark with each student Continued DNA discussion previously begun Laboratory exercise
November 4	Checked homework assignment given previous day Discussion on protein synthesis Showed video program on protein synthesis Discussion of carrot calli and cloning Interview II
November 6-10	Tom absent on author-related trip
November 13	Introduction to genetic engineering interactive debate Students begin preparation for debate or position essay
November 17	Period shortened by one hour due to presentation on teenage suicide to total school population Students choose whether they want to debate or write position paper on genetic engineering Discussion on mechanics of debate Students continue preparation for debate/essay Conclusion of Interview III
November 18-20	Tom attends STS Conference in Boston
November 19—	DNA, RNA and Protein Synthesis examination
November 23	Tom shared highlights of conference with students Presentation of interactive debate
November 25	Position essay on genetic engineering due Discussion of genetic engineering Students check progress of carrot calli Began evolution unit

Table 6

Outline of Tom's Biology 30 Classes

September 9	Introduction to Biology 30 Discussion of solutions and concentration
October 19	Blood and Circulation unit Outlined mini schedule of unit Discussion of pressure in heart and blood vessels Demonstration of blood movement in goldfish tails
October 20	Demonstration using rubber glove to show blood pressure changes Discussion of blood pressure Laboratory exercise on venous blood pressure
October 21	Two laboratory exercises on blood pressure Discussion of blood pressure regulation Students do several application problems on blood pressure
October 22	Complete laboratory exercise Discussion of control of blood pressure Students do application problems from board Distribution of review sheets
October 23	Laboratory exercises due Discussion of capillary fluid exchange and the lymphatic system Gave reading assignment
October 26-27	Tom absent due to author-related trip to Newfoundland
October 26	Interview with principal
October 28	Discussion of antigens, antibodies, Rh factor, blood types
October 29	Blood and circulation examination
October 30	Students dressed in costumes for Halloween Returned laboratory exercises Returned and discussed exam Elaborated on Rh factors

November 2	Began unit on Respiratory System Discussion of anatomy of lungs using X-ray films Discussion of breathing mechanics
November 3	Discussed relationship of blood and respiration Application problems on breathing Discussion of oxygen and carbon dioxide transport by blood Students begin on assigned readings
November 4	Distribution of question sheet on respiratory system Laboratory exercise on respiratory system Interview II
November 5	Seminar day for review Discuss question sheet and do application problems from chalkboard Discussion on emphysema
November 6-10	Tom absent on author-related trip
November 12	Began cellular respiration unit Discussion of electron transport

Tom - The Teacher and His Teaching Milieu

Tom's Teaching Environment

Tom's courses are taught in a spacious brightly lit room which contains a laboratory area on one side. During the planning stages of school construction, Tom had a hand in the design of all classrooms. The room has access to an adjacent small greenhouse. A demonstration desk at the front of the classroom contains a sink. A retractable screen is centred over two large chalkboards. An overhead projector is permanently kept at the front of the room. Large windows, with storage cupboards below them, span the back wall of the classroom. Two sinks are situated in the counter

below the windows. Glass-faced cupboards filled with specimens, models and magazines are suspended on the other two walls of the rooms. The walls are adorned with mounted antlers of various deer species. These belong to another staff member. In one room, several skulls and pieces of tree trunk are displayed on the cupboards as well as a series of mitosis models. A flip chart stands to one side at the front of each room. The students sit on chairs at small tables arranged in rows. The laboratory area is set up into six self-contained areas with space for four people at each area. Microscopes are contained in cupboards at each area. Laminated pictures, including posters of the four major Alberta ecosystems, protists, the taxonomy tree, a microscope, the respiratory system, the five senses of the human body, and the human heart, are placed above the windows in each of the rooms. A large aquarium containing a population of goldfish is placed at the front in one of the rooms. The fish are used to demonstrate capillary blood flow. The floors are tiled and the acoustics are reasonable.

The science office is contained in a complex of two rooms removed from the biology teaching rooms. Teacher desks are placed around one of the rooms with a work table in the middle. The second room contains the full time assistant's desk and is mainly her area of activity. Audiovisual equipment was returned to this area after use. This office area was relatively empty except for interspersed short visits by various teachers to their desks. The biology courses are mainly taught by four teachers, three males, including Tom, and one female, although teachers tend to teach across disciplines. The teachers usually go to the staffroom to have their lunches. A large teacher workroom, adjoining the staffroom, is always a hub of activity. Student use of the library is pronounced.

Introducing Tom as a Person

Tom is a teacher in his late-thirties who embarked on his teaching career in 1974. Attending the University of Alberta, he obtained his Bachelor of Science degree in Honours Biochemistry and enrolled in a Master of Science program specializing in physiology. Although all coursework was completed, he did not complete his thesis work and instead entered the Professional Diploma After Degree (PDAD) program in the education faculty in 1973. Tom holds a permanent professional teaching certificate and completed a masters degree in 1983. All teaching experience has been in the urban setting and with the exception of one year in junior high school, all experience has involved teaching senior secondary high school students. Trying to maintain currency in the rapidly changing field of biology involves reading periodicals, such as *Science*, *Discover*, *Science Digest*, and *Scientific American* as well as attendance at numerous conferences. Being an avid reader, Tom estimates that he yearly reads 100 books. Tom belongs to the Alberta Teachers Association Specialist Council in Science and has served on several government curriculum committees including the 1984 Biology Ad Hoc Committee which structured the present biology curriculum, and the "Scope and Sequence for Skills, Concepts and Attitudes" Committee which produced a document reference that is being used as a corner stone for the revision of the science courses in Alberta in accordance with the Secondary Education Review. Tom works on a consulting basis with the Evaluation Branch of Alberta Education. He has often served in the capacity of Chief Marker for the Evaluation Branch by over-seeing the marking of diploma examinations. Tom has been a contributor at several conferences including the Greater Edmonton Teachers Convention, Alberta Teachers Association Science Specialist Council and conferences in St. John's, Newfoundland, North York, Ontario and Winnipeg,

Manitoba. Tom is one of the swimming coaches of his school's swim club (over 70 members) and serves on his school library committee, budget committee and home room committee. Tom is married and has three daughters.

Tom aspires to be a successful author of biology textbooks and already has to his credit several published works. He is, at this presentation, the senior author on a series of general science texts that are aimed at the grade 10, 11 and 12 levels.

Tom is the academic coordinator in his school which is akin to being the department head of the academic courses including science, mathematics, English, and social studies. In addition to this assignment, Tom teaches 5/8 full time equivalent. His present teaching assignment includes two Biology 30 classes and one Biology 20 class.

During his high school teaching career, Tom has taught Biology 10, 20, 30, Chemistry 10, 20, 30, Science 11, and Mathematics 10, 13, and 15. Although Tom teaches for the Catholic (Separate) School Board in the city, Tom is known and respected among his colleagues from both systems. His opinion is often solicited by other teachers.

As I found with Catherine, Tom also responded in paragraphs to questions during the interview process. The style of interviewing was purposely designed so that the interviewer said as little as possible in framing the questions. The questions were open-ended and encouraged the respondents to compose their own answers and allowed them to speak freely and at length on the subjects in question. This contributed to the extended monologues that are quoted in the findings.

In response to my probing as to why he became a teacher Tom responded in the following way:

I: Why did you become a teacher?

T: Well I guess I was teaching at the university in the lab situations. I enjoyed the teaching aspect more than I enjoyed the research aspect. I was also, I

thought, better at the teaching than I was at the research. I was not a very careful scientist. I look more like a galloping gourmet than an analytical chemist certainly and I guess because of that I found that I enjoyed it and I looked forward to the teaching aspect and one of the things that bothered me about the labs - I guess didn't bother me because I enjoyed doing them - the labs at the university were so structured that I saw better ways of doing things I guess. I thought it would be interesting to have my own classroom and you know be creative and try some different things. I saw the university doing the same things year after year and some of those labs were six hours of material that you try to cram into students in three hours and I guess wanting the freedom to be able to try different things and I wasn't given that freedom at the university so I thought it would be neat to teach high school or junior high. To have your own science class and that I guess was what got me into it.

Since Tom was involved in other areas that could easily lead to a career change I asked whether a career change was a possibility in the near future:

I: Any thoughts to changing careers?

T: You know that I have had some opportunities to do that and I haven't. No. I enjoy some of the other work that I am doing that is associated with the school and really my job has more diversity than almost any other job that I look around and see. I teach, which is something that I really enjoy doing. ... I'm not teaching 100% of the time either and I have breaks and some of the breaks are good. I think it is really positive if I do a number of other things from semi-administrative which is good for me. I have some other things that generally keep my interests up.

The following excerpt from the first interview outlines Tom's opinion of himself as a teacher and as a person:

I: What kind of a person do you see yourself as?

T: Tired! (Laughs) One that seems to..Ahh I'm active. I don't think that I am afraid of trying things. I have tried a number of things all of which don't succeed. A person that quite often takes on a little too much and runs himself down, a person that has to become a little bit better at delegating work, and asking for help, I would think.

I: And maybe saying "No"; better at saying "No"?

T: And maybe saying No, yeah I gotta do some of that in fact I have been lately. I have been saying "No" to the Evaluation Branch. I dunno..I'm happy and I think that is important. I enjoy what I am doing so I think I am very lucky too. So if I was to describe myself it would be happy or lucky and some very positive things generally when I think about it.

I: What kind of a student were you?

T: Not a great student in high school.

I: Now what do you mean by that?

T: Academically I was not a 90% student. I was lazy in junior high. I was a very poor student in Grade 6 as a matter of fact. I almost failed Grade 6. I went into Grade 7 and sort of a whole new world opened up to me and I did very well in Grade 7 because of a science teacher. Grade 8 and 9 I got a little lazy. It was a different school I was at. It was a shame. Not the same quality of science teacher. It affected me. I got a little lazy and then I always sorta knew that I was going to university and sorta picked up my academics between 10 and got a little bit better in 11, better yet in 12 and kept going into university. I was a good student at university. I had high marks at university but as a high school student I can...I know what their feelings some days were.. "Oh no! Another day of notes and.." You don't take it personally. I guess if you've found everything super fascinating, exciting, and you were always a top notch student you may not always understand others.. I think I do.

What characteristics does Tom admire in other teachers? The following excerpt from the interview data gives some clues:

I: I would like you to think of one or two of your teachers and what you admired about them. What characteristics did they have that inspired you or perhaps you just plain admired or perhaps you tried to emulate?

T: ... I mentioned a teacher in Grade 7 who's very enthusiastic, yet spoke broken English, ..certainly wasn't the type of individual that you would think would..and most people didn't really like him. But from a personal note he developed some self-images, self-esteem, encouraged me. Something that I try to do to others. And he didn't know that when I went in I was a good student. That consistently high marks were possible. He believed it. I guess that was important. I think of other teachers who had a sense of humour which is certainly important. There are some days that we all feel down and if somebody is there that can look at the lighter side of things and sorta recognize that education is important but it's not so important that it's rare that you can never sit back and laugh and you can have a good time and enjoy the process. I guess it's probably those two things are things that stand out in teachers that I have admired.

Tom tries to build these two characteristics into himself and his own teaching: building a positive self-esteem in students and exemplifying a sense of humour. For example, in his introductory lectures he tells the students that the pseudonym that I am going to employ for him is Tom Selleck and he notes, much to the amusement of his students, that there really is not much difference between himself and the movie actor. At another point in the introductory lesson he describes a urinalysis laboratory exercise that the students will perform and describes what information an analysis of urine will reveal to

students:

"the crystals will give you some information about what you have been eating and how healthy you are and what kind of drugs you're on. No!"...

In a lesson concerning high blood pressure and the chances of getting an aneurysm, Tom cautions the students about playing doctor by relating a humorous story:

T: ... you get a headache and you say "Oh no, it's an aneurysm!" And it's always a little scary because when people start the labs they always start to give a diagnosis. There was someone this morning who was taking blood pressure and they had the person sit down. We're gonna take your blood pressure. And they said it's 140. Wow! you've got high blood pressure cause it says right here average is 120/80. Well it was a guy who had four girls around him taking his blood pressure! (Laughter) Well let's be perfectly honest about it. (More laughter) There was nothing wrong with him at all! (Whole class laughs.) And 140 isn't all that high!

And on building self-esteem Tom states the following:

I: Yeah, I noticed that you praise them a lot. Like there will be a question..an answer perhaps or an attempt at an answer that is 99% wrong but you'll find that 1% that was right and compliment them to make them feel good.

T: Well yeah, and it depends on who it is, too. I mean that there would be some that would be devastated if you say "No, you're out to lunch." I mean I'll do that on occasion and it will be with somebody who has a lot of confidence and I'll say, "No, you're wrong." And they'll smile and I'll smile but the interaction is the smile. And they should learn to accept that too. That at this point too we are doing a little bit of guessing and a little bit of synthesis. They are not expected to know all of it so..

When asked about his priorities in life Tom replied:

I: What are your priorities in life?

T: Oh good god, Cheryle! Ahh..I..

I: Am I jogging you to think about them, maybe?

T: Actually you are. You know, I guess family is probably the number one priority. So obviously not..

I: When you say family, what do you mean by that in terms of providing them with material things, or taking care of them that way..what do you mean?

T: No. Naaah. Being with them. In fact rather obviously there are some places that I could have made more money than what I am doing and you know money has not been the major..laughter..to me.

I: I know that!

T: So I guess self-esteem personal self-esteem. I would like to be considered by colleagues and mostly by students - that's much more important - a good teacher. Ahh..I want to be a father that's there for my kids and I guess that's the number one priority. I want to make myself available to them. I want to be open to them.

Tom re-emphasizes this point when he explains what his philosophy of education entails:

I: What is your philosophy of education?

T: Student self-esteem is probably what I work on the majority of the time. I have been a successful coach not because I have had the best swimmers or the best athletes because usually they weren't the best athletes. They are usually the little guys that no one else wants to deal with. ... I guess it is just being positive trying to be positive in the classroom to let them know when they get a wrong answer but to recognize that it is just a wrong answer. There is no big problem in getting the wrong answer. There's..You take a chance and it's people, I guess, that don't take chances that never really learn. It's kinda interesting because when our school board brought in this policy on excellence a lot of teachers, school board officials especially, interpreted excellence as meaning the best of things and that is not really my philosophy. My philosophy is maybe being the best that you can but it's that expectation that we should be the best that prevents a lot of people from trying things. It holds a lot of people back in developing skills that they may actually develop and you may start and not be very good at it at all and it is only after a year or two that you really become very proficient. So I guess if I have a philosophy too, it is to prevent the type of stratification where students look at one particular student and say well now there is someone that is really good in his class. He is a real good biologist. That really may not even be true. Most of biology is not writing exams and getting high marks and for them to appreciate that there are a lot of aspects to it. I guess, too, sort of foster an environment that helps their self-image is probably the most important thing.

In summary, Tom changed his scholastic pursuits from a masters degree in science specializing in physiology to a career in education because his experiences as a teaching assistant in the university laboratories provided an enjoyable teaching experience. He felt that he could creatively adapt teaching and thus changed faculties. He describes himself jokingly as tired and qualifies this by saying he takes on too many projects. He says he is one who is not afraid to try new things even if they do not succeed and describes himself as someone who is not very good at delegating work. He admits that he was a very good student (meaning that he received high marks) in university. He

admires teachers who use humour and encourage students to be the best that they can be. His life priority is his family. Tom's main philosophical principle is to build a positive self-image in students.

The School Milieu and Tom's View of Students

The student population of Tom's school is 830 which is very close to maximum capacity for which the building was designed. The school was constructed three years ago and is beginning its fourth year of operation. It is the only school in the separate school system that draws its student population from within specified boundaries. Located within a new, somewhat isolated suburb of the city, the school draws its students from a mixed community that contains high socio-economic groups as well as low ones. The students come from diverse ethnic groups. The principal reported that a survey in the first year of operation showed that English-speaking white people were in the majority followed by a high French-speaking white population. Students of Filipino origin were third. Recently there has been an influx of Black and Asian students.

Because the school has boundaries, only local advertising is utilized. Students are enticed to the school by its reputation as an outstanding diploma school (meaning that the school achieves high averages on diploma examinations) and the excellent extracurricular program including athletics and fine arts. Instead of traditional department heads, the school is experimenting with the use of coordinators who oversee the operation of several departments. For example the academic coordinator, which is one of Tom's roles, is responsible for the smooth functioning of the English, social studies, mathematics and science areas.

The school is described in the school handbook as being "semi-semestered". Most grade 12 courses are semestered as are the three-credit offerings. Grade 10, 11 and five-credit courses are not semestered.

How does Tom view students? The following excerpts from the interview data outline some student characteristics that are deemed to be important to him:

I: What are some desirable characteristics of a good student?

T: Interest. Curiosity. I guess that's about it. Some respect. That's kinda essential (laughter).

I: What sort of things symbolize, in your eyes, a bad student?

T: I guess someone that doesn't want to try. Usually they are afraid to try. Usually they are afraid of failure. Boredom. They are not interested. They come into class and they are lethargic. They are almost defying you to teach them and that to me is not a good student. I mean, we have all met them. There are kids that seem to be bored with everything. No matter what you do they are bored with it. They wanna do something else really.

Thus Tom expected students to be interested in the subject matter, to show curiosity and be respectful. He was not enthused with students who did not want or were afraid to try new things. He disliked students who were bored and disinterested in the subject.

Tom had expressed the importance of building student self-esteem as one of his priorities as well as an admired characteristic in teachers. He explains how he tries to make students feel good about themselves in the following interview excerpt:

I: How do you go about making students feel good about themselves? I know that was one of the things that you said that you liked to do. How do you go about doing that, though?

T: Aah...sometimes you just have to sit down and talk to them on an individual basis when they are not doing well. I did that yesterday actually with one girl who came in to see me. Aah she was really getting frustrated; she wasn't doing well in biology. Sometimes you just have to tell them that because they are not doing well now that doesn't mean...that they won't do well in the future. It's a real misconception that we have is that kids that do well in high school are going to be good biologists or good students. They are just good at that time and there's...it's just like athletics. You can be a great sprinter in grade 4 and get fat by grade 7 and you can't run anymore whereas other kids who weren't very coordinated

gradually developed those particular skills and I guess it's for them to realize that there are differences but that those differences change and what's really important is that a person..I really don't know which kid is the brightest kid and I hear a lot of teachers talking about so and so is really bright. Well they may be really bright but there's probably a lot of other kids that are equally as bright and I don't really think we know who's bright and I think that we can give an evaluation based upon you know, content and it reflects their..their..at least understanding at that particular point in time. But to tell you who is really bright and who isn't, I have no idea so I guess it's..It's that understanding and to try to transmit that we all have different skills and different abilities and that we all struggle in different things.

Homework was a student expectation. He explains:

I: You gave assignments for homework. Why do you think that is important?

T: I think there has got to be a commitment that they make beyond what we do in classroom and I think that is a ..certainly a commitment that they are going to have to make down the road be it a science class or any other kind of class or a job that asks for a particular responsibility. You know, so I think number one that is certainly a reasonable expectation. I guess the other thing is to attempt to cover everything in class. Means that my class has to be so incredibly structured that we don't do anything other than strict content so when I do some of this extra stuff some of the responsibility falls on them to do some work at home. I would think that that would be the case for most high school classes.

I: Today for the first time I actually saw you checking some.

T: Ummhuh.

I: For the 20 class. How do you know that it is done?

T: I check for the 30s on occasion too. And I'll take off marks if I catch them twice and their homework is not done. That's what they were talking about.

I: Oh that was the one chance that ..

T: That was the one chance and I keep a record of it and I'll dock marks pretty liberally because I feel that I make a commitment and I feel that they have to make the same commitment. Everybody forgets once. I mean there are days that I am sick and I can't get a lab done, corrected, so I am willing to accept that but they have got to recognize that I am pretty relaxed about lots but that there are limits and it's a good way of defining the limits.

Thus Tom felt that students have to make a commitment and by doing their homework they were showing Tom that they were committed to his course.

Tom envisioned the role of the student to be one of active involvement. Laboratory exercises, interpretive and application questions, the interactive debate and homework assignments stressed student involvement, commitment and responsibility in

the teaching/learning process. Examples of this will be presented in the following section which describes Tom's views on biology and biology teaching. He urged students to talk to one another and to discuss the questions that they were assigned. This process made concrete Tom's view of learning. Although he gave lectures, his comments were interspersed with questions to the students and usually culminated in questions which forced the students to synthesize the given information and apply it in slightly new or different ways. He thought that the role of the student should evidence a personal commitment to learning and therefore valued student characteristics such as curiosity, interest and questioning. The role of the student included being the best that you can be and he constantly praised student efforts and cajoled them to reach a little higher. He wanted students to be enthusiastic and interested and constantly modelled his own enthusiasm and interest in the subject matter.

Tom's Views on Biology and Biology Teaching

Tom tends to subsume biology under the more inclusive heading of science. He notes:

T: ... a right answer is not always what science is about. Science is a hypothesis and how you would test for your hypothesis or how you would conclude or refute [your hypothesis].

He describes one of the few handouts that he gave out in the following way:

T: I did hand one out before you came and that was when we did meiosis and mitosis and it was looking at meiosis and it was an article on nondisjunction and Down's syndrome and it was a one page article. And it was just speculation on why older women and of course it was just a theory..it was really three different theories that they were examining and I wanted them to recognize that science doesn't always have the answers and that a lot of it is theory and speculation and then testing and validation and those kinds of things.

In a conversation about the direction that evaluation of biology learning should take, Tom reiterates his ideas about what biology and science should be as follows:

Those are the types of things that, if it really is an interpretive science, which it is, the conclusion has to stem from your initial hypothesis and that we have neglected. We really have. We..we're still looking for a right answer and a right answer is not always what science is about. Science is a hypothesis and how would you test for your hypothesis or how would you conclude or refute that your..

Believing that science, and by extension biology, is a process of testing and validating hypotheses leads to Tom's strong preference for the laboratory approach including self-design laboratory exercises. He notes that "most of biology is not writing exams and getting high marks and for them [students] to appreciate that there are a lot of aspects to it."

In his introduction to Biology 30, Tom stated that the students would be doing about 30 laboratories. He comments about laboratory work:

I: Why do you have students do labs? You have already told me that you think that ... in terms of the projects they are going to do more reading. . What about in terms of the labs? You said you did an awful lot of labs. ... What sorts of things are they going to get from them? And why do you do so many?

T: Well one of..I guess it's just sort of an overall philosophy. One of the things that I said is that they learn a lot from each other. And it provides that opportunity. They question and they look at other people's results and they want to know why they are different. They want to know how somebody else can be right and have different results than they do. So they become critical thinkers, I think. Or at least it provides the opportunity to become critical thinkers. It is not a lot of things that pay off on exams, you know you can say that the things that happened may make them better scientists. I don't know that that's true or not. It's all in what we consider a good scientist to be but I guess that's number one. The other thing is that it is a change of pace. ... They..they have to do a lot of tedious things that I never used to do. I do more worksheets than I used. I do probably more exams and I guess I won't compromise on this. You know, I don't teach it the same way that I used to. It was a lot more open and if I didn't cover a unit it was OK you know, but not now..

I: And it's because of the diploma?

T: Sure it is. We have all modified our teaching because of it. There have been

some good things, I guess. There have been some negatives. And I think that the negative is the fact that I've got a sort of internal clock saying I've got to do two weeks of review and two weeks of review is like watching the paint dry. I mean it's.. it helps their marks. It does show them how the different systems are interrelated but it's not great. I mean, I used to do one lab and then somebody would say, "How about this?" And I would say, "Let's do a lab. Let's figure it out." I don't do those things anymore because I just don't have time. ... What I am also finding now is that the diploma exam is asking more and more in the way of specifics and I think less and less in the way of critical thinking. And you and I both know that you can teach concepts and application and understanding really becomes knowledge if you do enough of these type of things. And I guess I'm in..in a quandry because I don't want to go all that way but I have succumbed to some of it because they need the marks. And I mean to have kids have a wonderful learning experience and not have the marks to get into university..Am I doing a favour!?

Tom likes to vary his laboratory exercises from year to year. The other teachers do not do the same laboratory exercises as he does. He elaborates:

I: Do you..In terms of deciding what you teach is it pretty well an independent type of thing then?

T: No. In that we follow the curriculum but we don't lay out specific labs. The reason that we don't is because I don't want to follow specific labs every year.

I: Yeah. You want to vary them.

T: Yeah. I want to vary them. And I don't think it's anybody's prerogative to tell chemists - chemists that - Our chemistry teachers follow Alchem so they do much the same thing probably more so because it is more..

I: Because it is laid out.

T: Because it is more laid out. It is more structured for them. Biology - no. Now (name of teacher) and (name of teacher) are doing the Bio 10. And they did pretty well three bacteria labs which were all the same. They were from my lab book. But nobody said, "Do these labs." Or would I ever want to.

Tom acknowledges that his work in doing laboratory experiments with his students and the writing of a laboratory book are two of the accomplishments that he most prizes. He comments:

I: In your role as a teacher, what accomplishments are you most proud of?

T: I would think good teaching or at least I..I hate saying that because I have never met anybody that said that they were a bad teacher, and I've met some horrendous teachers! But I think for.. and I recognize that I certainly haven't reached every student by any means, but I'm pleased with the fact that I can meet students years later and they remember me, they remember the classes, those

types of things. I'm proud of writing. It's, you know, something not everybody does, so..and I think, that I would like to think some of the things have been innovative. There are some very good things in the market but they are really traditional and I don't think that my lab book was traditional. I think that it has some unique features. There are lots of traditional things in it but there is something new. The issues book, was something that I didn't initiate certainly, but I think I added into it the interactive debate, environmental modelling labs, those type of things, you know, I think that's been unique. It's added another dimension to the science course - to teaching strategy in science so..

And when asked what he would alter in evaluation emphasis if he were the director of evaluation at Alberta Education, Tom was consistent in adding the following:

I: ... If you were the director of evaluation what changes would you make?

T: Well the one thing that I would look at in science, certainly, is a greater emphasis on lab skill, lab component. I would go the route that they are going which is the larger, open-ended. ...

I: When you say..You said something to the effect that you'd like to go or you agreed with the way that they were going with more open-ended. You can take that two ways..what do you mean by that?

T: Aah..The types of questions that we worked on this summer..

I: More of..

T: Yeah. In other words, if you answered this, this must be true. But if you answered this, this could be true providing that you have the following rationale. Those are the types of things that, if it really is an interpretive science, which it is, the conclusion has to stem from your initial hypothesis and that we have neglected. We really have. We..we're still looking for a right answer and a right answer is not always what science is about. Science is a hypothesis and how would you test for your hypothesis or how would you conclude or refute that your..

Therefore for Tom the laboratories provide:

1. the opportunity for students to learn from each other,
2. the opportunity for critical thinking and questioning,
3. the opportunity for students to do science like a scientist, and
4. a change of pace for students and the teacher.

The re-institution of diploma examinations in Alberta has modified Tom's teaching style so that he says he is not free to do as many laboratories as he used to. He is proud of the

laboratory manual that he has co-authored and considers it one of his major accomplishments. If he were given the authority to change the curriculum, he would look at a greater emphasis on laboratory skills and if he were given authority to alter evaluation strategies he would institute more hypothesis testing types of questions.

Tom challenges his students. He likes to pose problems for his students that will draw information together and allow analysis, synthesis, evaluation, and application of data. For example on October 21, he laid out the following data for his Biology 30 students who were working on a unit concerning blood and circulation:

1. A person is in a car accident and the nerve between the carotid receptor and medulla is destroyed. Explain what happens to blood pressure.
2. The sympathetic nerves leading to the arterioles of the right arm are cut. The right arm turns pink and feels warm. Explain.

Tom gave the students some time to work and then used the discussion of this question to lead into a demonstration. On October 22 the following problem was put on the board:

Subject	Heart Rate beats/min	Systolic Blood Pressure mm Hg	Diastolic Blood Pressure mm Hg
At Rest Sitting	70	120	80
During Exercise	180	220	120
2 min after exercise while sitting	170	200	45

- a) Explain why systolic pressure before exercise is less than systolic pressure during exercise (1 mark)
- b) Explain why diastolic pressure after exercise is lower than diastolic pressure before exercise (2 marks)
- c) Explain why the diastolic blood pressure during exercise is so much greater

than the diastolic blood pressure after exercise. (2 marks)

For this problem, Tom distributed paper and expected students to answer the question for five bonus marks. The answers were handed in for marking. While the students struggled with the question, Tom commented that he expected the students to talk and confer with each other about the question. He cautioned the students not to "overthink" the bonus question in terms of sympathetic and parasympathetic stimulation which was the topic of the previous bonus question. He walked about the room and let students know if their answers were correct, incorrect or on track. The students handed the questions in and then Tom discussed them.

The following is what Tom had to say about his strategy of asking questions of students:

I: What do you feel you're accomplishing by your strategy of always asking questions of the students and giving them application type problems where they have to use what you have talked about before.

T: Try to keep them awake for one thing. Laughs. It's amazing if you just ask them recall questions, only the one that gets the recall question thinks. The other ones don't because it's a recall question so it isn't personally relevant to them I guess. Try and get them involved but I think beyond that is demonstrating a reason for the information and the reason is more than just answering the questions. It's application and sometimes they come up with application questions and so for a physiology program to be a good physiology program I believe it's got to be application oriented.

Tom is also persistent in obtaining an answer to his questions but is careful about building and maintaining the student's self-image. He explains:

I: When you ask questions, you're quite persistent. You don't let them off the hook very easily. Why are you so persistent?

T: I think once you establish the fact that they can get off the hook too easily - you don't want to embarrass them - they just do that - I don't know.

I: You usually fish out. You usually get some..

T: Some kinda of an answer!

I: Some aspect of the answer.

T: Well I try to. If you go to somebody else..if you do it continually they

I: Turn off?

T: They feel pretty negative about questioning. They anticipate not getting it. And at least if they get one small part of it, I mean, you have restored some of

their self-image sometimes. And sometimes when they are really frustrated and they're kinda flailing you do have to leave them and go to someone else because you are just going to continue to increase their anxiety.

Tom also is sensitive to the idea that his questioning strategy is not accepted by all students. He elaborates in the following conversation when probed about this:

I: ... How do you think the students adjust to this questioning and application type of teaching strategy? Cause I'm sure that this is quite different from what they are used to.

T: Some not well. Interestingly, when we wrote our lab book we tried to put some of that kind of questioning into the lab book and of course it's a lot less than what you can do in person but one of the teachers indicated that it was the better students that were having trouble. ...

I: They are so used to memorizing.

T: Yeah. They are used to being able to find a definite answer in the book. And she said they were looking to the textbook and it didn't have the answer. They were getting really frustrated with the textbook. And I said, "Well, maybe that's not what we want." And so it's just that.

I: It depends on what the teacher does with their frustrated..

T: I mean, it could be awful.

I: Especially if the book doesn't have it.

T: Oh and the book usually doesn't. A lot of the questions that I ask you won't find the answers in a textbook. And a lot of it isn't and that's the other thing in physiology is that it isn't the whole story and I have to start somewhere. And I know that to an extent I am probably creating some misconceptions but the misconceptions will be cleared up I think as they go along..at least a lot of them. Some of them probably won't. And I have come to realize that as soon as you do application and you have only done the circulatory system and you haven't done the nervous system to accompany it, yeah there are gonna be kids that think you can now answer everything in terms of the circulatory system for an inflammation response, for example. I am aware of that and I am aware of the fact that when I talk about histamine it's just one of many things. ... And for other teachers they don't think..For them it's important that kids know that there are histamines that do this and something else does that and I can't really argue that point. I mean they're right that students should probably understand that there are a lot of different things. But to me it sort of comes to a point that I'll gloss over that..This is one of the things but I'll give them something that they can recognize and histamines is an example because it's a name that they have associated with antihistamines so it's a different focus. And I know that I drive some people nuts because they would say..why those kids don't know..I mean you are getting into things that are really beyond core and you are not really giving them the whole story.

I: You often get them to write..well you always get them to write their answers down and sometimes you take them in. Do you find that most of them attempt the stuff?

T: Yeah they all attempt it...almost always attempt it. To write it out gives them a little more time to organize their thoughts. And when I ask them something verbally there is a pause and (name of educator) is the guy that should talk about this because you know he feels that a lot of teachers feel that students should have answers like this - snap, snap, snap - and that's not realistic. When I ask them a question, I ask them to write it out, it is less strain than the pause and it is also more time to organize. So that is what that does for me and you need time to organize your thoughts. You don't make those connections instantaneously especially in some of the questions that I ask. ...

Tom tries to ask questions of everyone in class as illustrated by the following:

I: One of the things that I noticed about your questioning is that quite often you start out by addressing a particular person...(name of student), I want you to think about this..and then you sort of concentrate on that particular person. Do you think by doing that, by naming one specific person, how do you think that affects the rest of the group? Or do you think that it does?

T: I don't think they relax. You know, I used to think that you ask a general question and then you go in and you specify. I found out now that because they know me that when (name of student) answers some of it, I'm immediately going to switch so message is there and what I'm doing is that I quite often pick out somebody that I haven't asked. ... The other thing I guess is that if you ask a question to the class and I've been in the situation, you can have a class dominated by four individuals or three individuals and then you start to avoid them. And that's no good either because then you avoid the people that are most interested. That makes no sense so I'll come out and just ask a particular individual and I'll try and move it around. There are probably some..some kids that I am a little easier on because they may have a speech impediment or a language difficulty but I won't avoid them completely.

Asking questions of students is a major teaching strategy. He realizes that some students do not adjust well to this strategy but he attempts to make them feel good by finding a small correct part of their answer and praises them for it. He also tries to show students that his class is a safe environment and it is not the end of the world if they answer incorrectly but it is important for them to try.

Project work is important to Tom and the students in Biology 20 were involved in growing carrot calli. (A callus is an undifferentiated mass of cells which can be manipulated to grow into complete organisms - each with the same genetic make-up as

the callus tissue. Thus unorganized masses of tissue are manipulated to obtain clones.)

The following explains why Tom likes doing projects:

I: My first question had to do with the project. You are obviously doing a lot of extra work, you know in terms of looking for resources, hiking over to Prairie Biological, talking to whoever over there, just simply thinking about the thing. What sort of rationalizations do you use to convince yourself that it is worth the time and effort?

T: The way that the kids were talking in there. They rushed over. I said to them that sometime between now and quarter after...a couple of minutes after...a minute after I said that they were all over talking about it. So it wasn't me pushing them, trying to stir the enthusiasm - it was there. And I think as it starts to grow now I am just going to leave the door open and you know, they are going to go in there and they are going to look and I guess that's their rationalization.

Tom's views on field trips were important for rationalizing why he assigns them a lower priority than either laboratory work or project work. He explains:

I: How do field trips fit into your teaching?

T: Field trips are really tough to do. Aah..

I: Why?

T: You're looking at the fact that there are so many field trips already in the school.

I: In other?

T: Yeah in other areas. We had an assembly today which was an important thing on teen suicide but it's a matter of actually pulling the kids out and knowing full well that they are going to miss half. Some of them are weak in math. So I tend to run it differently. What I used to do is, matter of fact, I used to run a Saturday field trip and credit them with that time off class the last week of class in June which was a benefit to me and a benefit to them. Aah...it would be the week just before they wrote exams and we would finish off biology and I would say, "Well look we're supposed to put in 62.5 hours and we put them in and we put in six hours on a Saturday so you have six hours off class." And that worked. What I tend to do now is that they do almost independent field trips and they do that as part of their project. Now winter is not the best time to really do the field trips but I have them do pond studies and pond-lake studies and some mixed woodland studies as part of the 20 project. Of course this is the spring project. We'll do some winter ecology right in the school yard. So yeah, we do it. We don't go to Ministik Hills, there are teachers, (name of teacher), is one that does. And he has been successful at it but the expense, the disruption to do it for every kid in the school is really tough. ...And the other thing is, I mean, what they supply is good value but it's awfully expensive when I look around and I say, "Well for that same price, I could do something just as dramatic in my own school yard." And that's being creative. It's that you don't have to be in a natural environment. You

can do some really creative enthusiastic things right out in the school yard. And snow ecology is a good example. You can do that anywhere.

Tom likes doing project work because students are enthusiastic about it. The value of field trips, for Tom, can be derived by doing innovative laboratories like snow ecology right in his own school yard. Field trips, Tom feels are too disruptive of other classes and very expensive. However many students do independent and individualized field trips in relation to their project work.

Tom very rarely uses handouts as part of his teaching strategy. When questioned about this, Tom responded in the following way:

I: You use very few handouts. Is there a reason for that?

T: Yeah. Big kids don't read them! I really do! I think that getting kids to read more than what is in the textbook, you're kidding yourself. In most cases, unless they get going on a particular project and they want to read it. And I don't think you..handing stuff out is going to make them do it. I think question sheets are different because what question sheets make them do is review their notes and review what's in the textbook. But you're not going to get kids to read articles for the most part. ... And what I find now is that we do a library orientation session and we do a good library orientation session and the kids in the school use the library like no other high school in the city. And the kids go and you saw some of that today and we don't have to tell them to go and look something up....

I: So the only kind of handouts that you use are like maybe diagrams for practice and question sheets and that kind of thing.

T: For the most part. Occasionally I've got a couple of ones on future drugs that I do hand out that some..very occasionally I incur research but I may end up two or three a semester but that's it.

Handouts are seldom used because Tom does not feel that students read them. Question sheets, on the other hand, allow students to review notes and textbook readings. Tom also feels that his students use the library whenever they are required to do some supplemental readings other than the textbook and rather than being given these readings in selected handouts they look up pertinent information themselves. Of high priority for Tom is that students understand the personal relevance of biology to

people's everyday lives. He explains:

I: What do you think the "heart" of biology is? What are the most important things that you would like to get across in teaching biology?

T: Well I think from my perspective it is beyond the content of biology and that is that biology touches their lives. It is number one immediately personally relevant. They come away with that I certainly have accomplished something but I think a future goal - or further goal rather - would be that they have a responsibility to others and that there is a certain amount of biological, scientific literacy that they should possess in order to appreciate the impact that they have upon others, and the impact that they have upon the environment. That there is a purpose in learning and understanding biology.

I: ...When you say that you want them to know that there is purpose to biology, what do you mean by that? Can you expand on that?

T: Well I think on the very personal level when we do physiology for example, it's an understanding of their body and how they function and to understand growth developments, to understand differences too between different people and different organisms, to appreciate interaction - man and environments, man and man, all of that certainly is biology....

I: ... OK What is the nature of effective biology teaching in your view with that value and that philosophy then?

T: Well..obviously student involvement. The other thing is that I want to provide them the opportunity and I don't know if you have seen much of that yet, the opportunity to interact with each other. What we usually do is have some seminar days after labs are finished and throw things out and get into small groups and I guess my feeling is that they can learn as much from each other about content in biology and I'm not talking about higher social values and things like that. I'm talking about actual biology content that they're going to learn from me. What I have to do is sorta lay out some challenges for them. And to make it reasonably interesting I guess is the other thing. It's that it has to be interesting. There is some content obviously that we do and it is didactic at times. There is no such thing as totally interactive biology because there is some terminology and some phraseology and some basic core material that they have to develop and understand before they expand upon it. But I guess providing the opportunity that they can do some critical thinking; providing the opportunity that they can do some application and that's teaching to me.

Illustrations of the personal relevance of the content which Tom is teaching about. For example, in a lesson on cells, Tom was talking about cellular components in student lunches - chicken muscle cells, muscle cells in ham, lettuce cells, bacterial cells in yogurt - and he explains his purpose in using this example as follows:

T: You know what I was trying to do was get them to look at what they take as obvious and to really consider the wonder in what was obvious to them. Because it is something that they all know and something..but I don't think that people really stop to consider it. By showing enthusiasm and saying, "Hey, this really is special!" that maybe they will. And a lot of them won't, but I think that a number of them will sort of stop and say, "Hey, yeah, I never thought of that! That really is unique. That really is important!"

He criticizes the present Biology 10 course as not being personally relevant and lacking application:

T: I don't like teaching Bio 10 very much at all and I find that Biology 10 for the most part is a waste. It doesn't have very much application. It's a survey. It's a lot of facts. Even the dissections and the things like that, that the kids enjoy doing are really limited. I look at the time that's put into Biology 10 and what's accomplished and I don't think it's a great program. In fact if I had my way I'd throw out the survey and do it a very different way. ... A comparative systems approach rather than a phylogenetic approach would be a far far superior method.

Tom translates his beliefs about science and specifically biology into his teaching strategies. Thus his constant use of personally relevant examples, his extensive use of the laboratory approach, and his continual encouragement to have students interact together embody the scientific endeavour as much as is possible in a secondary school classroom situation. For Tom, effective biology teaching must incorporate student involvement and interaction among students and between the teacher and the students. As well, effective biology teaching has to be interesting. To this end, Tom consciously works at bringing in contemporary articles and pieces of research that he encounters in his extensive reading and research for his authoring work. He states:

T: And every year there is always something that is new and it's exciting and I seek things out. I seek things that aren't in the biological supply companies although there are really some good things in some of the kits. Some of the kits are not practical because they are so expensive but I'm..I continually try to

bring new things to motivate me probably and then if I get motivated it is easy to motivate the kids.

and

T: I would like to think that I am enthusiastic and..and..I mean I do a sales job on kids too. I try to get them excited about it and get them reading about cloning and stuff like that.

Teaching also must provide an opportunity for students to apply the content knowledge that they have learned and to think critically about it. The nature of effective biology teaching takes the form of student involvement. He wants students to learn science (biology) by doing biology as a scientist would. Strategies that will allow Tom to bring to fruition his beliefs about effective biology teaching involve the laboratory approach, use of demonstrations, and challenging students with application and interpretative type questions and problems. Tom estimates that he and his students spend at least 40% of classroom time doing laboratory work. He states:

T: I prefer the laboratory approach whenever possible but I recognize that it is a very time-consuming approach. And you can't do a 100% lab course and ever get through all the material. I hate saying that because you think of the individuals that say "I can't do labs because I'll never cover the course." and that is not what I mean at all. But there has to be a balance and I try to provide that balance. I usually look at least 40% on labs.

His lectures are a mosaic of content gathered from a multiplicity of sources that are interspersed with questions. Students are allowed time to think about the questions because "they have to go back and synthesize on the spot and put some of the information together and call on the previous day's information". Student answers to questions are occasionally rewarded with bonus marks which are special marks not included in exams and other assignments. Sometimes the students write their answers and hand them in for marking. Other times the students demonstrate their answers on the chalk board and still other times they orally explain their answers. On some occasions Tom will write a

student's oral explanation on the chalkboard and use it as a springboard for discussing further content in his lecture. Tom says:

T: Well it's I guess, it's a feeling that either the lecture comes from me or they're involved. A lot of times I'll say, "It's a great answer!" and I'll want to add things as I go. It's, you know, you can't put them down for feeling involved.

A quick demonstration often precedes the lecture and sets the tone for the information that is to follow. For example Tom demonstrates with a rubber glove the answer posed to a problem which he outlined as follows:

During exercise the heart output increases five times but the arterial pressure only increases two times. Why does the arterial pressure not increase five times as well?

Standing at the front demonstration desk which contains a sink, Tom cuts the ends of two fingers, puts the glove on the tap and opens the tap emitting a very strong flow of water and in fact splashes a few people at the front. The students can see that the uncut fingers, which represent arterioles, swell (dilate). Tom asks why the arterioles dilate. He continues questioning until one student notes that the exercise would cause accumulation of metabolic products such as carbon dioxide which would cause the dilation. Tom accepts this and continues.

In summary, Tom establishes an environment in which students do science and focusses upon himself as a facilitator of this process. He agrees:

I: You view your role as a facilitator like your administration! You've used their role in a lot of ways.

T: Sure to a large extent. I mean, there are a lot of things that I still do that are very traditional teaching.

For Tom the most desirable teaching and learning environment was exemplified by the following:

I: What kind of a learning environment do you think fosters the best teaching/learning?

T: Well..I mean for wanting(?) which students are not afraid to make mistakes. They are given an opportunity to try some things. I still believe that it has to be structured; it's not an open environment by any means. But there has to be some structure and some direction but they're not locked into a lock-key step so as they move from Point A to B to C that they're told what to do, that they're treated as if they have some brains, that they have to figure a few things out for themselves and how to get a task accomplished or something like that. I think that those are probably the best environments. Those don't always come up as often as they should though. In my classes as well.

I: So you like working with large groups of students or do you prefer smaller groups?

T: Depends upon what we are doing, I guess. There are certain situations where when we do the labs, I specifically put them into smaller groups so that we can walk around and sit down with a lab group sometimes and just talk a little bit about what they are doing. Generally I prefer if I am doing a lecture, I don't prefer 5 to 10, I would rather have a full house. ...

How does Tom go about setting up the best type of environment for teaching/learning?

I: What do you use as the main determinant of course content and way of instruction and evaluation in the courses that you teach?

T: Well course contents, you at least use outlines set by Alberta Ed. And I do follow it. I modify, like everybody else, and emphasize things that I am more interested in and that students tend to be more interested in. Ahh, I guess the presentation is appropriate, sometimes the supplies, the equipment.

I: ... What about your lectures and that kind of thing. Do you use a particular textbook or is it a mosaic of your background?

T: It's a mosaic and a lot of it is interspersed with questions. I think you've seen that today.

I: Certainly.

T: And I'll stop and give them time to think and sometimes it slows the whole flow down but that is important because they have to gather their thoughts. And sometimes it makes for a less exciting looking class but I think it is a more meaningful class for the student because they have to go back and synthesize on the spot and put some of the information together and call on the previous day's information. It helps to key them into particular things that I want to do in the lab. A lot of the questioning and demonstrations that I do are set-ups for things that I'll be doing later too so it's..

I: I sensed in your class, and again, my perspective, but I sensed a feeling of excitement when you gave them the question and they worked it out and they got parts of it right but they didn't quite get the whole thing and I could actually feel the excitement from them that was being transmitted and it was a nice feeling.

T: It was a challenge. Throw out a challenge and see what you can do with it.

I: Do you do that a lot?

T: I do that an awful lot. In fact we run..I give bonus marks all the time. ...It doesn't really change their report card mark but I guess there is something attached to it. Ahh..some of them don't need it and some of them do. It kinda shakes them along and gets them motivated for awhile.

I: ...Do you give them a bonus mark for asking super good questions or anything like that?

T: No. That is an expectation. That they ask good questions and I'll compliment good questions but no..

Consistent with the value Tom placed on students who tried, Tom felt that the best learning environment was one in which students were not afraid to make mistakes. He follows the prescribed curriculum but adapts it to follow his own interests and those of his students by relating the digressions to the core content. Occasionally supplies and equipment limit Tom's preference for using the laboratory approach. The expository aspects of his teaching are derived from a mosaic of sources and Tom says that he likes to introduce his lectures with a demonstration as described previously and likes to intersperse the lecturing with numerous questions.

Later, in another interview, the following ensued:

I: I was wondering what you used as a basis for determining course content? Besides the curriculum guide. You know, like for example..

T: Changes!

I: the callus stuff I mean, that is not on the curriculum. Is it just things that you encounter in your writing or books that you find..what do you use to sorta determine..

T: Every unit has something new..

I: Yeah..

T: And I guess that is just it. But I guess it is curriculum.

I: Oh I know it is curriculum but I mean you don't use Berry (author of prescribed biology text), for example, to determine the content of your Bio 30, you use the curriculum guide as your loose overall ahh..guide, I can't think of another word. But what else do you use that helps you to determine your content?

T: I guess what it is..is as you read and I read a lot..you pick things out. I did the thing the other day on aging. I thought, "Geez, this is really neat!" That aging, and sperm cells, and cancerous tumours..there is a relationship that is found in research. I thought that it was exciting and so I told them about it. And I related as best I could to what we were doing so it wasn't something out in left field. I

guess it is just that. If I find something that is interesting I want to tell them about it and usually if I am genuinely interested in it, I can develop some interest in them so a lot of stuff that I do isn't I guess, you would put quotations around it "core content" but it can become core content because you can use it to support your core content. The look that I give DNA is very cursory compared to what a lot of teachers do. I know teachers that really go at it. And I give them, I think, an adequate understanding of DNA. But I don't hammer home facts that you would get in an IB class.

I: There they would have to know the difference between a purine and pyrimidine and you know, how they fit together and what the bond is and all this kind of business.

T: Yeah and you see I'll bet that the kids that do the project for me are going to know this. They are not going to know it because I taught it to them. They are going to know that and they are going to know more about DNA, I believe, than the average kid out of an IB class because they will go to the library and will take out books. I mean you saw that today. Aah and maybe they won't learn every detailed..well all the detail that they would in an IB class and what an anticodon is and some of that stuff but they are probably going to remember a lot more than some of the kids that are just doing a lot of content and a lot of notes and not that that's bad but they are going to learn a lot of things that they find are interesting. And they are going to remember them because they find them interesting. And I guess it is sort of a different view of what's core and what has to be there. And the other thing in my class is that there is going to be a tremendous range in what kids know. Some of the kids are going to come out and probably not even know the basics and obviously they are going to fail but I would say that there is another pocket of kids that sort of knows pretty well what you would find in every other Bio 20 class but I would also like to think that I make available that opportunity to really go into something and you know, this year it is genetic engineering. Last year it was snow ecology. The year before that it was water quality. And all of those things become part of the curriculum.

Tom constantly altered the course content in his courses to account for changes in biological knowledge and to make his students aware of some of the latest research that was occurring. He also altered the content to maintain his own enthusiasm and interest.

Tom's Routines

Tom conducts his classes in a relaxed open manner. He appears genuinely happy to be in the classroom. Classes were often initiated by a short lecture, a demonstration or the solving of an application or interpretation type of problem that helped to

synthesize previous information. The Biology 20 classes, involved in the genetics unit, were asked to work out Punnett squares on the chalkboard and then worked on similar problems from a worksheet. There was no set pattern to the order of events but there was always student involvement in the activities. Attendance was taken each class period although Tom occasionally forgot and had to be reminded by the person picking up the sheets. While students were involved in questions or problems, Tom moved about the room, talked to students, encouraged them and gave them hints. Sometimes he would move around the room and collect materials for a demonstration that would follow a little later in the period. Tom's facial expressions and voice inflection aided in lively pleasant presentations. Teacher prepared prompt notes were used only occasionally to help organize his expository teaching.

Noon hours were often devoted to meetings. When there was no meeting scheduled, Tom would have lunch with various groups of people in the staff lunchroom and then spend some time preparing for classes. Immediately after school Tom coached the swim team at a nearby pool. Due to heavy demands on his in-school time by his academic coordinator's position, Tom marked all student work at home. Reading of biology-related materials and compilation of data for his many application and interpretation type questions and general preparation for classes were completed at home.

Classroom Management by Tom

The functioning of Tom's classroom proceeded smoothly and was unmarked by disruptive behaviours. This was even true for Halloween when many of the students were costumed and were somewhat giddy and hyperactive. Part of Tom's firm control of

the classroom is governed by respect for him as a person by the students and partly by the firm line of demarcation setting the student and teacher apart. Tom says:

T: They have got to recognize that I am pretty relaxed about lots but that there are limits and it's a good way of defining the limits. I am still the teacher. I'm not their buddy. I'm not their friend. They recognize that and that's why I wear the tie too, because I am very informal. And it's a dichotomy. I've never had the situation break down and I think that it's probably ..is that they still recognize that I am the teacher.

I: Have you ever had the problem of - or I don't know if it's a problem - of them wanting to call you by the first name?

T: No.

I: Yeah, cause I noticed that they are quite formal with you. Mr. Selleck - there is no question.

T: No in fact never in the school other than someone who has graduated and comes back and says it for a reaction. I dunno! I let them. But no, in fact they don't even feel comfortable with that. It's funny. All the students that..one guy is a doctor - I think I told you - and he said it still felt funny to call me Tom. (Laughs) And he's a physician. So yeah I guess it carries over.

I: It's that line that they don't cross.

T: I respect them as students and they respect me as a teacher I would think.

Tom minimizes the possibility for unacceptable behaviour by allowing students a choice of activities in which they can become involved. Tom elaborates:

I: ... In your ... Bio 20 ... - you have already got three different groups of students - you've got your cloners, you've got your debators, and then you have another big group that hasn't chosen anything. You seem quite comfortable with that. ... I was wondering what that phrase "control of students"... means to you and how do you maintain control?

T: Good question! There is a group of debators may indeed be some of the group that's doing the cloning. So it is not even three distinct groups. They will all have to do one thing so there is no question and sort of the debate is separate from the project type of work so indeed I expect that some of them are doing the cloning work to partake in the debate. Those that don't of course do the paper so they all have to do some work. Those that..the reason that I am starting the cloning right now of course is because it takes more time and this weekend I came up with a third thing that I want to do in the genetic engineering that is even more exciting than the cloning but you know, I guess, it's keeping track of where you want them and I know that the other groups can start in January and simply be able to accomplish everything in January. This cloning group will be doing more reading and researching about cloning. That's what January will be for them. It will be just reading for the most part although I've got another thing that I am

going to bring in for them which is pretty exciting so really that is what I am looking at. It's really a coordination of facilities, and students, and timing and I don't know really if there is control..there certainly is not the control that you would have in a classroom lecture situation where they are all focussed upon you. There is control in the fact that the focus is upon learning. Or it should be. The opportunity is there for it to be on learning.

I: In observing you, I get a strong sense that you are definitely the authority in the classroom. Like I mean you're bossman. ... How do you maintain that authority and how do you enhance it?

T: How do I maintain it? In different classes I really do different things. I am more formal many times with the 20s than I am with the 30s. With the 30s there really isn't ..it's understood as to why they're in there. In a 10 class I tend to be more directive, very much structured. I don't provide them with a lot of opportunities to screw up early in the year. I mean it's certain labs that are structured labs and we don't do a lot of self-design things and I guess that accounts for some of it. If there is anything it is tailoring your lesson to the maturity of the student. You know, taking into account interests and other things, motivation. Of course you don't want to be so structured that it's day to day lectures which in 10 it isn't. Actually in 10 I do the greatest number of labs but they are very structured labs so it has never been a conscious thing to sit down and analyze it. But I guess the activities to an extent ensure control. The other thing is that kids just generally don't push if they are doing something that is reasonable like they have no reason to be disruptive. And I find that they discipline each other just by peer pressure and when most of them are on your side they're going to have to take a chance to oppose you and characteristically they don't. Although you will run into some but they are usually ostracized by their own class members if they try to push it.

If students are motivated and interested they are not likely to exhibit poor classroom behaviour. Tom maintains student motivation by changing his projects and activities so that he and the students continue to be interested. He says:

I: You are all excited about something new that you were going to try in genetics. Do you have a guide or what is it that drives you to choose them?

T: No guide.

I: ..certain materials that are really beyond the curriculum and they motivate you somehow. What is it about them that allows you to choose them?

T: My own interest.

I: Your own interest.

T: Yeah. And every year there is always something that is new and it's exciting and I seek things out. I seek things that aren't in the biological supply companies although there are really some good things in some of the kits. Some of the kits are not practical because they are so expensive but I'm .. I continually try to bring new things to motivate me probably and then if I get motivated it is easy to motivate the kids.

In summary, Tom manages his classroom by demanding and receiving respect for him as a teacher, partly by his dress, by minimizing the chances for disruptive behaviour, by presenting his courses as a "doing" discipline, and by presenting motivating activities that the students have some choice in selecting. If students respect you, then they will help you by enforcing their own classroom discipline.

Tom's Introductory Lessons

Introduction to Biology 30

As students filed into the first Biology 30 class of the semester, Tom exchanged animated comments with various students as they entered and found a table and chair to sit in. Tom asked the students, "So did anyone do anything exciting this summer?" Tom seemed to know most of the students and spoke to them by name. After the buzzer rang to indicate the beginning of the class there was some general chatting and then Tom began to call out names. He used no formal attention getting device to signify that he was ready to begin the class and did so by calling out names:

T: Laurie, you're still here? Michelle, Sandra, Mike..

This was done for all the members of the class on the classlist and then Tom questioned if there was anyone that was present that he had not called and asked that these people come to the front to see him. The remainder of the class chatted among themselves. Tom then asked people to move to the front of the room voluntarily before Tom would do it for them. Students complied on their own and all seats at the front of the class were filled.

Tom then proceeded to introduce the course in the following way:-

T: Biology 30. I'll tell you a little bit about the course and you'll see if you want to stay. (Laughter)

He then introduced me, allowed me an opportunity to explain the research to the students as well as time to distribute the release forms. He then explained that I would be using a pseudonym to refer to him and that this was going to be Tom Selleck. Much to the students amusement, he noted that there wasn't much difference between the movie actor and himself. Tom then continued,

T: Everyone is so serious. You really want me to tell you about the Biology 30 program. Let's tell you about Biology 30. I think it's the best course in the school. That's pretty biased. It's a course about you. If you want to know what happens when you sit up and why your blood pressure goes up, why do people faint, why do people get varicose veins, why is your urine yellow - you probably always wanted to know! Right? Well we will even have you bring some in if we can still do it and we'll give you a nice little container and we'll get you to bring it in and we'll do an analysis and we'll look at the crystals that are in there. The crystals will give you some information about what you have been eating and how healthy you are and what kind of drugs you're on. No...(laughter) We will be doing 30 labs from now to January. That's a lot especially when each write-up takes about an hour. We learn by doing and looking and discovering things. We will be doing a lab by Friday and that tells you a little bit about how I run this course. This is a laboratory course. In a laboratory course there are certain expectations that I have and one of which is that I enjoy having fun and clowning around a little bit - well a lot some days - in the lecture part but I don't fool around in the lab. Labs are serious and I'm organized and I hope you are the same. And I treat labs very seriously and they are an integral part of learning. Even labs that mess up. Some of the times I have learned more out of the labs that didn't work than labs that do work. And the other thing that I want to alleviate some fears on is that I expect sometimes that we get lab results that we just have a heck of a time explaining and some of those labs become the best learning experiences. You never do a lab one day and hand it in the next. That is something else. I believe in another day to sorta think about it again and then we hand it in either one or two days down the road. So I believe very much in the chance to do the lab and then go home and think about and think about it for another day, interact with others in the class and sometimes you will learn more from them than you will ever learn from me and correct things too about what you are supposed to be doing. That's the biology in the classroom. It's amazing how much you are going to learn from each other. Probably a lot more than you will learn from me and I really emphasize that. So I encourage the interaction. I encourage you to talk about what happened in your lab. What I don't encourage is that you all hand in the same lab write-up. OK? I mean I am not that dumb. And I used to do it. And I know how it's done. So at least have the good sense to do an

independent lab write-up and that is one of the things that I demand but I don't want to get into a negative thing. I'd like to tell you a little bit about how the course is aligned and report card marks and some of the administrative trivia..I think the report card marks you may want to write down so you may want to open up your book. 'Cause report cards are either the first, second or third.

Tom wrote the following on the board:

Report	
1st	30%
2nd	35%
3rd	35%

Then he said:

T: Notice how I named them? The first one comes at the end of October and it's for 30 percent of your mark. The second one comes in the early part of December and it's worth 35 percent of your mark. The third one, of course, is the end of January and it's worth 35 percent of your mark. What you can see is that we don't start off like a lot of courses do and the first couple of weeks don't mean much. NO. The course is pretty well equally distributed among the three reporting periods and that means that the first one is worth just about as much as the other two. We are not easing in. We are going right at it and it's an important point.

S: How does the final Biology 30 exam come into that?

T: Actually I am going to show you how it comes in. OK? And that is a real good question. What I do is give you an evaluation scheme that is very easy to figure out and you'll never have to ask me what your mark is but I'll tell you anyway because it's one of those things that we want to make sure we are on the right wavelength.

Tom went on to give a detailed account of how a report card mark is derived based on a specific case. Tom then continued:

You should know what your mark is throughout the course and what I suggest is that what you do is pick up a duotang or something in which you can keep your labs and keep your labs and your exams in the duotang. The duotang might get fairly big by the end of the year but that's OK. You can always buy another one. The beauty about that -or a binder if you like. The beauty about that is that there's your record book and if I make a calculating error you can come up and say Mr. Selleck you made a mistake. And I'll say "What do you mean I made a mistake? I'm perfect! I don't make mistakes!"

Tom goes on to give a specific example of a possible error that the teacher may have made and how the student can double-check the computation. He then goes on to outline his testing routine:

I usually give a week or a week and a half notice before an exam. Every Monday when you come in I give you a week's schedule so you know exactly what's going on in that particular week. If we have to modify or change something I'll...I'm not adverse to doing that cause sometimes I've scheduled an exam for Friday and we've not covered as much as I want by Friday so we bump it on to the next week or something but I'll always give you a Monday's schedule. So you'll always know what your marks are and you'll always know what's coming and you'll always know where you are going to be.

Tom then apologizes for not having a course outline handout for the students. He says:

What I'll have run off for you too is a program outline which is right here. I'll have it for you tomorrow. I would have had it for you today but somehow I ended up doing a lot of other things that somehow today seemed unimportant. Anyhow I'll have it for you. It's not essential for you to have it today. I'm just saying it will say here's where we are in the course and these are the things I have to know and these are the things that we will do next and this is the number of pages in the course outline that we have to do before we are done. It's kind of a good way of keeping track of where you are and I think it's really important.

Continuing with his introduction, Tom talks about the Biology 30 course in global terms.

He says:

So things that I want to tell you about the Bio 30 program - I said it is human physiology, biochemistry, there is even some stuff called biophysics and that sounds really impressive but it's not very difficult stuff. The initial part of the course is sort of a building block and that's what we are going to start with and then stuff that is not super exciting at the beginning. Although it shouldn't be boring but it is stuff that is going to build so that we understand why the heart works a particular way or why water moves into a capillary or why it moves out of it. Those are some of the things we are going to lay the basis for. When we look at digestion we have to understand something of biochemistry. We even have to understand something of biochemistry believe it or not to understand how our immune system works and how our nervous system works and certainly how the hormonal system works - some of the regulatory functions of our body. So what we are doing is building a base of knowledge that becomes application.

Tom then compares the prerequisite biology courses to the present course and relates extra work that the students can expect to the fact that this is a diploma examination course. He concludes by praising the students. He states:

Bio 30 is so different than Bio 10. Bio 10 - if you can remember way back then - all that you did - is that we showed you jars of really gross things and you tried to remember how they fed and how they reproduced and what they were classified as. Well Bio 20 changed because remember then you started to do some application. Ecology had a lot of application and certainly the genetics was mostly application. It wasn't a lot of memory work there. This one is kind of a synthesis of the two. Because there is some basic memory work but the basic memory work allows us to apply things and some of the things that we are going to apply become very exciting and immediately relevant because they are things which concern your health, the way in which your body accommodates strenuous exercise for example, what happens when you have a high fever, why is it dangerous, why do fevers kill people, why you get a fever - those kinds of things. So there is, I think a lot of immediately relevant things that are in this course and because of that with 30 labs, it's got some work. Bio 30, like all diploma subjects, is a course that you are looking at work in and I'm going to be very honest with you up front and I want to indicate to you that most nights you are looking at half an hour and some nights it will stretch into an hour and I'll try to keep it under the hour because I recognize that you have other things such as chemistry and physics and occasionally there's a good hockey game on - right? And those kinds of things. It won't be a killer. It will be a positive course for you but I want to be up front and let you know that there is a lot of work expected and I expect that you will deliver. I know a lot of you and I'm not worried. I know that this is a good class.

S: What about the final? Does that incorporate those marks up there?

Tom goes on to describe the Alberta Education examination strategy. Because this is a diploma examination subject, student concern about evaluation is not unexpected. Tom concludes his introductory comments by assuring his students that if they do well in class they will do well on the diploma examination and gives them a specific illustration from the previous June marks. He concludes by saying:

Well all that I can tell you is that you'll enjoy it, you'll like - I demand that you like it! I insist that you like it. We are going to start!

Tom immediately began to explain cellular processes and started with an explanation of the following terms: metabolism, catabolism, anabolism and homeostasis. At this point a person came to the door and noted that Tom had not completed the attendance for the

first day. Tom noted that already on the first day he had messed up, completed the required information on the sheet, and gave it to the person. Students were immediately involved in the definition of the terms and some applications were already being given as for example, Tom defined metabolism and then asked,

T: (name of student) what does a high rate of metabolism mean?

This work continued to the end of the period.

Introduction to Biology 20

Until the class began, Tom talked and joked with various students. I wrote in the field notes that one "gets the feeling that Tom is happy to be here". As in the Biology 30 introduction, he asked the students to occupy the front tables and assured them that it is OK as "he had no sweat -he had showered in the morning!". He left the classroom momentarily but none of the students moved to the front. Upon his return, Tom moved one of the students and then others moved on their own. Tom began:

T: I am going to ask you to fill out the seating plan just to have a name to attach.. We are going to start off with a little bit of an overview of the biology course and try to re-acquaint ourselves with some of the things about biology. First of all, I see that most of you have the textbook and certainly for the first while bring the textbook. We get into a couple of sections of the course where it is not really required but I'd like to just tell you a little about Biology 20. It is really quite different than Biology 10.

Tom goes on to contrast the grade 11 course with the prerequisite grade 10 course. As he did in the Biology 30 introduction, he goes on to describe his grading practices and supports his verbal presentation with brief notes on the chalkboard. He describes the Biology 20 course in the following way:

One of the things in the Biology 20 is that we are going to start off with the section that really looks at cellular reproduction. So we grab your interest right off by

talking about reproduction. (He writes cellular reproduction on the board.) OK. We are going to be taking a look at genetics (writes genetics on the board) which is the structure and study of genes. And along with that is another unit called DNA and DNA I consider really a part of genetics so that is the same thing. A lot of those words you may not remember so we are going to explain some of those things and go through them. Another section that we are going to do is on evolution. (He writes evolution on the board.) It is a fairly small section but a very important section. And evolution is a much broader topic than a lot of you think it is right now. ... We are going to take a look at another unit which is ecology. And ecology is a look at the environment and environmental factors that affect man and how we affect environmental factors. We are going to look at something here that is a project. (He writes "project" directly below ecology.) And I wanted to spend a little bit of time this morning telling you about something that we are going to do toward the end of the course. And that sounds like an odd way of starting a course - telling you something we are going to do at the end of it. But it really isn't because a lot of the material that we are learning is designed to bring us to this project. And I'd like to give you some examples of some of the things that different students have done so you'll see where some of this material fits in. The projects that we are going to be doing are very much environmental projects.

Tom then speaks at length describing the nature of science and techniques that are used by scientists. He describes in detail one of the projects that his students carried out in a previous class. He lets the students know that he thinks projects are an important aspect of Biology 20 and signals the end of his introductory comments by asking:

T: How are you doing with the sheet? Just about done? You are done. What I am going to do in just starting off is just ask is there anyone here that doesn't have their textbook here? Have you just not picked it up or..

S: I wasn't here on Monday.

T: OK. Are we short of textbooks downstairs?

Tom proceeded to talk to individuals who gave an assortment of reasons as to why they did not have their textbooks here.

T: OK. What I am going to do is that you are going to move beside somebody. I am going to give you some terms that I want you to look up. Now I am not big on terms but before we get started on the cell looking at cell division there are some things that I want you to look up and to re-acquaint yourself with. Because if you are like me after a summer you don't remember a lot of the stuff that was probably second nature. So what I want you to do is copy the terms down, leave a couple of lines between them. But you know, what is ideal is don't write down textbook definitions I don't believe that textbooks define things so we can understand them. What I want you to do is put it into regular student English. OK? In other words put it in a way that you can express it and it means

something to you. Don't talk about colloidal gels and things like that. Some of the ways that they describe cytoplasm for example in the book, you have to read it over about five times and you are still not sure what they said so don't be afraid of using terms that you are more familiar with. In fact that is what I want you to do. So these are the things that I want you to write down. Leave about two lines. If you can remember what they are without looking them up..

Tom wrote the following terms on the board: protoplasm, cytoplasm, nucleus, chromosomes, cell membrane, nuclear membrane, genes, and DNA. The students that had no texts moved together with others and all began to work. While the students were working, Tom, who was at the front of the room, looked through a folder of material. He then called the attendance and students acknowledged that they were present. He did not ask students to correct the pronunciation of names as he already seemed to know most of the students by their first names and he used the freshly constructed seating plan to aid him with identification of students he did not know. After allowing some time to determine definitions for the assigned terms, Tom discussed the students' definitions by enlarging and expanding the information as he thought necessary. When he got to the terms "genes" and "DNA" he talked about the cloning experiments he wanted to conduct with the class. The students became very interested. At the conclusion of the period, Tom gave a homework assignment that would help prepare the students for the impending laboratory work.

Summary of Findings about Tom

Aspects of Tom's functional paradigm, which were revealed in the interviews, classroom interaction audio-tapes and field notes, are summarized in Figure 3. Tom's scholastic background includes a Bachelor of Science degree, coursework for a masters degree in science and a Master of Education degree. He is married and has three

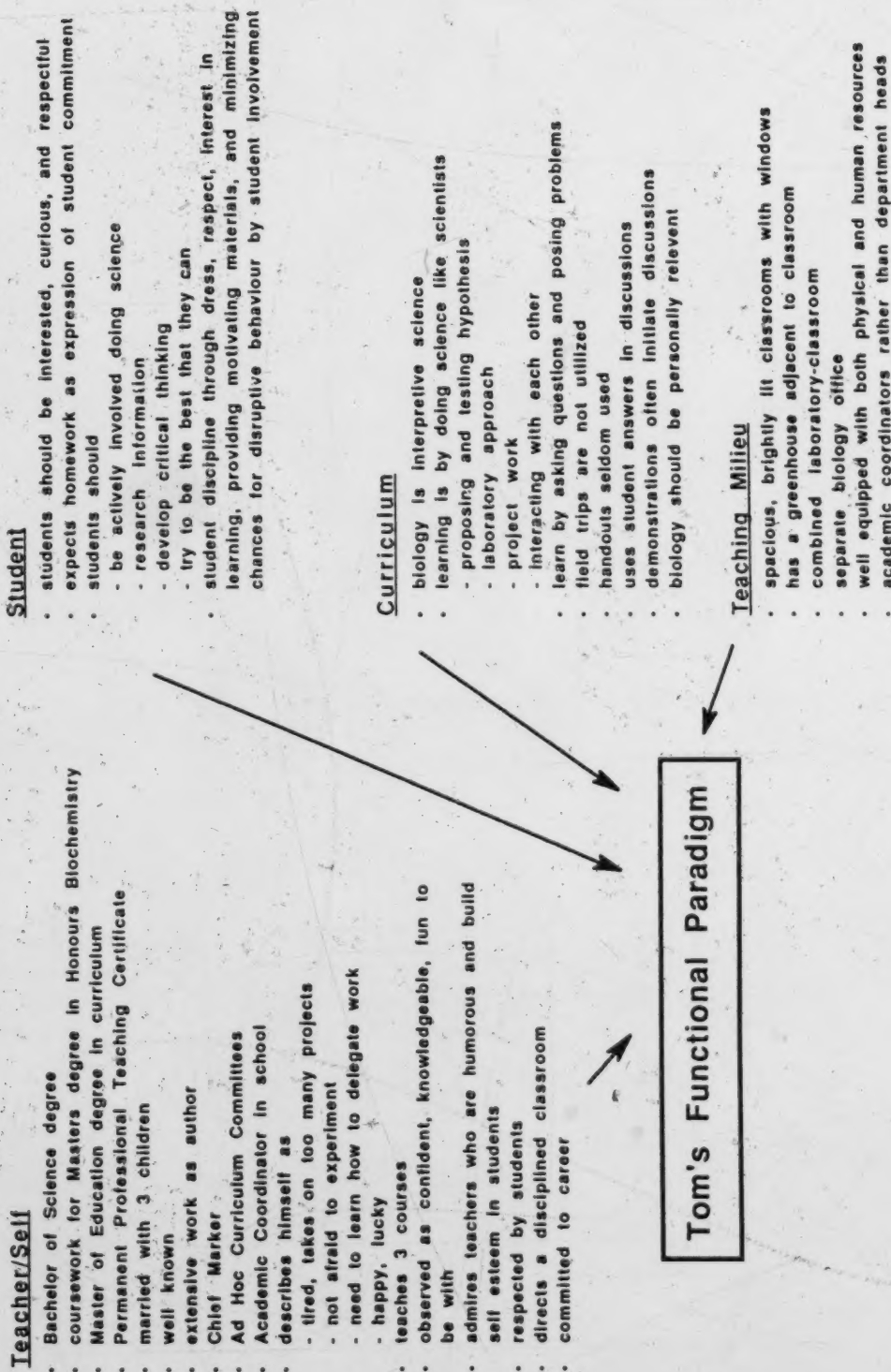


Figure 3. Aspects of Tom's functional paradigm

children. Tom teaches three courses and is involved in administrative duties as academic coordinator for the remainder of the school day. Tom is well known among his colleagues and his professional expertise has been solicited through committee membership on, for example, the 1984 biology ad hoc committee in the curriculum branch of Alberta Education and as chief marker for the evaluation branch of Alberta Education. He has published work and is currently involved in authoring a proposed series of textbooks. Tom describes himself as tired, and active, that is, as someone who sometimes takes on too many projects and has not learned how to delegate work. He says he is not afraid to experiment and describes himself as happy and lucky to be in a job that he enjoys. He is observed to be confident, knowledgeable and fun to be with. Two characteristics that Tom admires in other teachers - a good sense of humour and the ability to build positive student self-esteem - are emulated. Respected by students and staff, Tom is a popular teacher who conducts a disciplined classroom. He is committed to his career in education and says that he has no plans to change although opportunities to do so have been presented.

Tom thinks students should be interested in the subject matter, curious and respectful of both each other and their teacher. They should:

1. be actively involved in doing science,
2. research information for themselves by using the library,
3. develop critical thinking skills, and
4. be the best that they can be.

Tom does not like students who do not try and are bored or those who are not interested in the subject matter and would really like to be somewhere else. He maintains student discipline through student respect for him and therefore students tend to discipline

themselves, through his dress, which usually includes a sport coat and tie, through his interest in the subject matter and his ability to motivate students as interested and motivated students are not disruptive, and by minimizing the opportunity for disruptive behaviour by engaging the students in actively doing science like scientists.

Tom believes that biology is an interpretive science and learning it is by emulating the process of science that scientists follow, that is, by proposing hypotheses and validating or refuting them by observed experimental evidence. Therefore, Tom prefers teaching techniques that support this belief including the laboratory approach and project work. Because scientists continually interact with each other, Tom encourages student interaction and discussion of experimental evidence and prompts students to learn from each other. Tom assigns field trips a lower priority than either laboratory work or project work because he believes that the same values that field trips offer can be achieved inexpensively and with less disruption to other classes through creative adaptations of laboratories in his own school yard. Because Tom believes that students should be applying, interpreting, analyzing and synthesizing biological knowledge, he constantly asks questions or poses problems that will allow students to practice these skills. Handouts are seldom used because Tom believes that students do not read them. In the presentation of biological knowledge, Tom incorporates student answers and comments because this helps to involve students. Demonstrations of principles often initiate expository segments of Tom's teaching. Biology, Tom believes, should be personally relevant and he works hard trying to relate biological concepts to everyday experiences.

The observed immediate teaching setting is remarkably the same for both Tom and Catherine. They teach in pleasant classrooms with convenient access to laboratory

facilities. Equipment and resources do not appear to be lacking although I neglected to further explore the milieu with either of the teachers.

Like Catherine, Tom also establishes many aspects of his functional paradigm with the students during the sequence of events in his introductory classes. Tom does not introduce himself either by writing or telling his name or describing himself. He engages in animated conversation with students as they enter the classroom and appears to know many of the students by name. He immediately uses humour to tell the students that it will be fun being in his classes and thus signifies the importance of humour to him. He catches student attention by telling them that biology is the best course in the school and is personally relevant because it is about them. Within the first few minutes of his introduction, he tells the students that they will be doing science via the laboratory and project approaches. Evaluation is an important aspect and Tom shows this by spending some time explaining how student report card marks are derived and the importance of student maintenance of a record of their own marks by illustrating with a specific example. Student questions regarding examinations are not unexpected and show student concern.

Tom tells the students to expect a schedule of events every Monday and to expect prior notice of examination dates. True to his word, Tom follows through with this promise at the beginning of each week. Tom apologizes that he does not have a course outline handout ready for the students and foreshadows the low priority that he places on handouts. He describes the course in a general manner by posing questions about the subject matter. This heralds the emphasis that Tom places on posing the very same type of application, analysis, interpretation and synthesis questions during the subsequent coursework. He warns the students that he expects a certain amount of effort and

commitment on their part by comparing the amount of work that they did in the prerequisite course to what they will be expected to do. However he concludes by praising the class and leaving a positive self-image - something that he works on doing throughout the observation period.

In the Biology 20 introductory classes, Tom uses the majority of his introductory comments to specify the nature of science and thereby shows the emphasis that he places on the doing of science by performing laboratory and project work in this course. In both classes Tom spends the latter part of the period involving the students in learning some course content, specifically some definitions. In the Biology 30 class, he asks students for definitions and uses their definitions as a springboard for further discussion just as he does on many occasions during the observation period and in the Biology 20 class, he asks the students to research definitions in the textbook and to work together thus heralding what he expects students to do in subsequent classes.

CHAPTER V

SUMMARY AND DISCUSSION

In this chapter the method of data collection and analysis is reviewed and the research questions which guided the study are used to summarize the data collected. Based on the literature reviewed and the data collected, generalizations are made. The findings are used to suggest further research.

The data collection and analysis was guided by the following questions:

1. What are the elements in the functional paradigms of two senior high school biology teachers as inferred from the teachers' own statements?
2. To what extent are the elements of these teacher's functional paradigms present in classroom activity and discourse?
3. What values and/or world views influence these biology teachers' interpretation of classroom function?
4. What is the relationship between espoused teacher views of classroom function and of observed classroom function of that teacher?
5. How are these elements of the functional paradigm established and communicated to students within the classroom setting?

A Summary of Data Collection and Analysis

The data for the two case studies in this research were collected by utilizing qualitative case study methodology including audio-taped interviews with the two selected teacher participants, audio-tapings of classroom interaction and field notes of

observations. Four interviews were conducted with each teacher over a period of two and one-half months from September to November. The interview questions were open-ended and were designed to elicit a full range of possible responses. Situational recall questions were utilized to probe why the teacher participants engaged in certain classroom activities. All interviews were transcribed. A total of 55 periods of classroom interaction were observed and taped in the two school settings. These were utilized in a subsidiary capacity to compare what the teacher espoused with actual classroom functioning. The field notes were also used in a supplemental capacity to identify instances of specific classroom interaction and to derive sequences of classroom activity.

The data were analyzed by categorizing the statements and interactions as they related to a modification of Schwab's (1973) four curriculum commonplaces: teacher/self, students, curriculum, and milieu. Data about the teacher, the teacher's views of students and curriculum, including strategies utilized to implement the curriculum were obtained from the interview data, audio-tapes of classroom interaction and the observation notes while data about the milieu was obtained mainly from the observation notes and an interview with the principal of each school. Discussion about the milieu with the teachers was minimal.

Summary of Research Findings

The research questions which guided the study are used to structure the following summary of the research findings.

Question 1: What are the elements in the functional paradigms of two senior high school biology teachers as inferred from the teachers' own statements?

The data appears to indicate that the elements that comprise the two biology teachers' functional paradigm as interpreted from the teachers' own statements are similar to each other although each teacher emphasizes some elements more than others giving an appearance of a different paradigm. In terms of data about the teacher/self, both teachers have a science degree but Tom has continued his scholastic endeavours and has completed coursework for a masters degree in science and has attained a masters degree in education specializing in curriculum. Both are authors; Tom has more extensive experience in this area. Both are well-known and respected by their colleagues. Both teach three courses each but Catherine teaching half-time, spends the remainder of her day looking after her child while Tom is involved in school administrative duties. Catherine describes herself as anxious, sensitive, gentle, says she has a temper and wants to get along with people. Tom describes himself as tired because he takes on too many projects and needs to improve his delegation skills. He also describes himself as a risk-taker as well as someone who is happy and lucky. Both appear confident and knowledgeable. Teacher characteristics admired by Catherine include being knowledgeable, being outgoing and friendly with students and maintaining a disciplined classroom; Tom admires having a sense of humour and having the ability to build positive student esteem. Catherine values good organization whereas Tom, although organized, does not appear to place as high a priority on it. Both teachers valued disciplined classrooms. Catherine likes to model behaviours expected of students

whereas Tom seems to be more direct and tells the students what he expects. Belief in himself and a high personal self-esteem characterized Tom while good organization and commitment to teaching were Catherine's strong characteristics.

In terms of each teacher's view of students, both had high expectations and both thought that students should be actively involved in their learning. However, Tom believed his students should learn science (biology) by **doing** science through laboratory and project work while Catherine believed her students should be actively involved learning **about** science (biology). Both teachers believed that students should learn how to think and Tom specified that students should learn how to be critical thinkers. It would be informative to explore this aspect of student expectation a little further with Catherine. Both teachers believed that students should learn how to research information and that they should try to be the best that they can be. Catherine specified that students should learn how to communicate both in written and oral form. Both teachers had well thought out schemes for maintaining a disciplined classroom. Tom believed that if students respected the teacher they would discipline themselves through peer pressure. Because he also actively involved the students in their learning and in the choice of some of the activities, students seemed motivated to learn and therefore were less likely to exhibit disruptive behaviour. Catherine on the other hand minimized chances for unacceptable behaviour by her tight organization. She also spent considerable time informing the students of policies, regulations and subsequent consequences if these policies and regulations were broken. She said she was consistent in following through with the consequences. Due to the amount of time devoted to explaining rules and regulations, it can be inferred that Catherine appeared to be more concerned about discipline than Tom.

Both teachers felt that biology was special because it was personally relevant. Tom, more than Catherine, appeared to stress that biology was an interpretive science. Tom emphasized that biology learning was by doing biology like biologists. Field trips for the whole class were of high priority for Catherine whereas Tom assigned them a much lower priority. Both teachers believed that students should be involved in discussions. Catherine placed a high value on handouts whereas Tom did not. Both teachers used demonstrations during their presentations. Tom was keen on building self-esteem in his students while Catherine exemplified a modelling approach with hers.

Both teachers followed the curriculum set out by Alberta Education. Any optional topics inserted by Catherine seemed to follow the interest of the students whereas Tom liked to change his optional topics continually because exploration of new topic areas motivated his own interest and enthusiasm. Thus it can be inferred that Tom placed a higher emphasis on following his own topic interests than those of his students. Catherine appeared to place a higher emphasis on the materials that she used. Both teachers seemed to place an equal emphasis on the relationship between the teacher and the subject matter. These relationships regarding emphases are depicted in Figure 4.

The milieu of both teachers was approximately the same. Both worked in large academic urban schools situated in middle class communities. Both teachers taught three classes each in two rooms with laboratory facilities either in the same room or in an easily accessible adjacent room. One school had an International Baccalaureate program for gifted students while the other did not and one school was part of the separate (Roman Catholic) school system while the other was part of the larger public system. These factors likely influenced the milieu substantially but the focus of this study did not pursue such investigations.

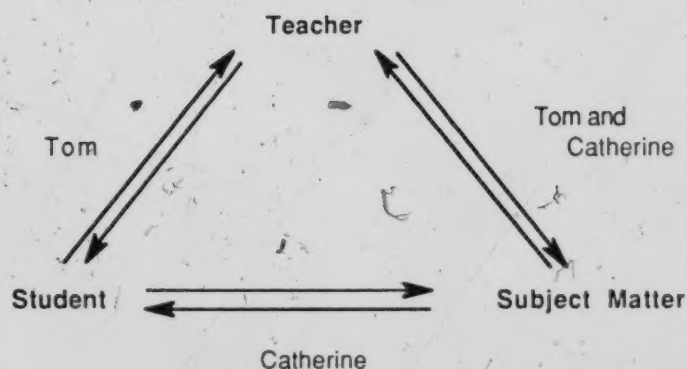


Figure 4. Relative emphasis that Tom and Catherine place on the interactions between teacher, student and subject matter

In summary, the teachers communicated a great deal of information about the elements of their functional paradigm in their interview statements.

Question 2: To what extent are the elements of these teacher's functional paradigms present in classroom activity and discourse?

Data from this study suggest that the elements of the teachers functional paradigm are very much evident in classroom activity and discourse however some discrepancies are also noted.

Tom's science degree and his graduate work in science and curriculum might have contributed to his view that science is a process and his interpretation of science as doing experiments resulted in the students doing many experiments. This view is confirmed by the findings of Lantz (1984). Perhaps, because Catherine did not have graduate experience, her beliefs revolved more around the concept that science is

content as she learned from her undergraduate courses and this was translated as learning about science and confirming this knowledge through experiments. Thus Catherine's students' laboratory work mainly reinforced what the students learned in class and was structured so that students replicated expected results whereas Tom's students approached laboratory work as hypothesis testing and were not looking for the "right" answers. Catherine had her students prepare pre-laboratory write-ups whereas Tom's students did the laboratory work and then prepared written summaries of the laboratory work for handing in.

Catherine says she has a temper and is anxious but these characteristics were not evident at any time during the observation period. Tom appears to be a little more consistent as he describes himself as not being afraid to experiment and certainly the cloning experiments with carrot calli were something that he had never tried before. He became sick with a cold which may have indicated his tired and run-down state from taking on too many projects.

The teacher characteristics that Catherine admired which included being knowledgeable, being outgoing and friendly with students as well as maintaining a disciplined classroom were evident in her teaching. The student questions concerning cones in the retina of the eye and Catherine's sophisticated explanation indicated an extensive knowledge of her subject matter as did her everyday explanations. Catherine often chatted with her students and was friendly with them. Her friendliness was particularly evident in times between and after classes. Tom admired a sense of humour and humour was evident in his classes. Tom valued building a positive self-esteem and often praised his students individually and collectively. Both teachers appeared organized in what they were going to do each day and when they were going to accomplish

it. Catherine appears to be more concerned than Tom about maintaining discipline as illustrated by her extensive review of regulations and policies during her introductory classes. Catherine said she followed through with consequences and this was evident when one of her students was unable to write the unit exam and had to write a long answer make-up exam which was different from that of the other students. Catherine had told the students that this was a policy and followed through with it even though the student challenged her.

Tom demonstrated his belief that students should be critical thinkers by accepting several "correct" answers to explain experimental data and by posing higher level thinking questions in which students had to analyze and evaluate data. During the observation period, which was during the first month of classes, little of this was evident in Catherine's classes although she had said that she favoured teaching students to think.

Catherine's and Tom's belief that students should learn how to research information was evident in activities during the observation period. Catherine's classes researched information on diseases during a library period and Tom's classes had to research information on the pros and cons of genetic engineering. Both groups of students were required to present their research in written and oral form.

Tom consistently related biology to his student's everyday experiences whereas Catherine indicated that she did this in specific units such as the human reproduction unit and in specific instances that arose in the course of teaching. Tom, more than Catherine, appeared to stress that biology was an interpretive science. Tom emphasized that biology learning was by doing biology like biologists and involved proposing and testing hypotheses and therefore was amenable to laboratory and project work. Although

during the observation period, both teachers had their students perform a similar number of laboratory exercises (six). Tom emphasized that this was how biological knowledge was arrived at and sometimes referred to his students as "biologists". Catherine appeared to emphasize learning about biology and, by using different techniques such as slide-tape presentations, demonstrations, analogies, handouts and laboratory work, she reinforced concepts learned from expository discourse.

Catherine valued her complete class going on a field trip whereas Tom favoured individual or small group field trips associated with project work and believed that whole class field trips were both expensive and disruptive to other courses that the student was taking.

Both teachers involved students by utilizing their answers in discussions. Tom posed many higher level questions to his students which allowed his students to analyze, synthesize, interpret and apply knowledge from expository discourse. This did not seem evident in Catherine's classes during the observation period but students were involved in answering knowledge type questions which Catherine used as the basis for further discussion.

Catherine gave the students many handouts during the observation period whereas Tom only gave the students the course outline from the syllabus and one handout in relation to mitosis and meiosis before the observation period.

Catherine and Tom demonstrated to a large extent many elements of their functional paradigm. Different teachers appear to have a somewhat different constellation of beliefs, values, techniques, exemplars, and routines and Catherine and Tom demonstrated some of these differences in the make-up of their paradigm.

Question 3: What values and/or world views influence these biology teacher's interpretation of classroom function?

Tom's value of viewing science (biology) as an interpretive science greatly influenced his interpretation of classroom function. Because he believed that science should be taught by doing science he actively involved his students in emulating the work of scientists in proposing and testing hypothesis by experimental evidence. This value guided him in choosing the teaching strategies (laboratory and project work, posing of analysis, synthesis, and application type of questions, the interpretation of data) that would allow him to consistently bring this value to fruition. Catherine valued learning about science. Therefore she believed that a multiplicity of presentations (slide-tape presentations, demonstrations, handouts, field trips, laboratory exercises) would reinforce concepts and allow students to retain them better. This value guided her in the choice of materials that she would use in her classroom teaching. Tom's belief that he would remain enthusiastic and interested if he continually introduced different topics for project work allowed him to give students a choice of topics and exercises that they carried out. This choice in turn gave students an ownership in their learning which minimized discipline problems in Tom's classes. Catherine valued organization and this value translated itself into an efficiently run classroom that minimized chances for discipline problems. Tom valued building self-esteem in his students and often praised students during classroom interaction for their efforts. This translated into a positive classroom atmosphere and in fact one of the students was overheard to say, "Mr. Selleck cares about us." Catherine valued modelling behaviours and this translated into her showing rather than telling students what she expected of them.

Catherine appears to value high influence teaching and seems to view her role as "teacher as navigator" (Olson, 1981). She ensures that important subject matter is transferred to the students in a process where the students pay attention to her. Catherine, with her superior knowledge of the subject matter, acts as an authority or transfers authority to the textbook. Although Catherine controls the direction and point of the lesson, she encourages student participation unlike the "teacher as prime mover" role. Catherine fostered question and answer sequences and guided discovery in the laboratory as, for example, in the case of the function of the microscope diaphragm. Tom's teaching, on the other hand, seems to be an example of low influence teaching (Olson, 1981). The students were practically involved a great deal of the time in doing genetics problems and solving higher level questions such as those on blood pressure, preparing for and carrying out the interactive debate, and performing laboratory exercises such as the experiments on carrot calli. Tom liked to view his own role as a facilitator. Because Catherine viewed her role as ensuring that important content be transferred to students and that students have a common base of content for ensuing examinations, her classes proceeded in an orderly and uninterrupted fashion. Tom's classes had a multiplicity of activities happening at once. For example, some students were preparing to carry out the interactive debate, all students were researching pros and cons of genetic engineering, some students were beginning experiments on carrot calli and all students were doing genetic problems. Tom revealed in the interviews that he struggled with ensuring that his students achieve high grades on the external examinations and that they engage in discovery learning.

Thus the values and/or world views that teachers hold are very important in influencing these biology teachers' interpretation of classroom function. This finding

confirms the findings expressed by Olson, 1981; Benson, 1984; Tomkiewicz, 1987; Franz-Lutzer, 1990 and others. It is also possible that teachers are not aware of what their values and/or world views are and therefore a clarification of these values may lead to a better understanding of themselves as educators (Cornett et al, 1990; Tobin et al, 1990).

Question 4: What is the relationship between espoused teacher views of classroom function and of observed classroom function of that teacher?

The data shows that there are varying degrees of inconsistency between what the teachers say about their behaviour and what they do. Catherine seems to show an inconsistency between elements of her paradigm and observed interaction when she states that, "biology is not sitting in the classroom, taking notes, and seeing films" but in actual classroom function that was observed a large portion of the time. However, Catherine capitalized on taking her students out of the classroom on field trips as often as possible and was willing to disrupt her proposed schedule in order to do this. Catherine states that education is a means for the student to become self-sufficient. One could question the extent to which her organization allows room for the students to develop in self-sufficiency. However, her homework assignments and the disease research project contributed toward building some of this self-sufficiency.

As with Catherine, I looked for examples of consistency in what Tom said and what he did in the classroom. Tom acknowledges that students have different skills and abilities and that they have to be the best that they can. Yet, he seems to impose a particular style of teaching on some students who do not do well with that type of

teaching. Tom is aware of this but feels that the good his style achieves outweighs the problems that it may cause. Tom uses worksheets as a mechanism for coping with the constraints that are placed on his teaching by his administrative responsibilities. This appears to be against his philosophy but appears to have evolved as a survival mechanism in terms of the demands placed on him by his administrative role and possibly the demands of the external diploma examination. Due to the short span of time spent in the classroom with the teachers and the fact that observation occurred early in the year, when Tom's administrative role is most active, it may be that those are inconsistencies which are rectified in other units over time.

Question 5: How are these elements of the functional paradigm established and communicated to students within the classroom setting?

The data from the current study suggests that the values, beliefs, routines, techniques, exemplars and routines are exhibited by the teacher during the first day of classes and are reinforced during ensuing classes. Catherine's penchant for organization is confirmed to the students by her organization of the course and the fact that all her materials are prepared and placed in the order in which they are to be used. Her value on a multiplicity of materials for her presentations is revealed to the students by the numerous materials, including four handouts, the board, and the overhead that she uses during the first class. The value that she places on letting students know where they stand and what they can and cannot do is exemplified by the time and detail that Catherine devotes to discussing rules, regulations and subsequent consequences of breaking those regulations. This discussion should have communicated to students that Catherine

maintained a teacher-directed classroom. Catherine used student answers as an entry point for further discussion and this signified that she expected students to do their readings and be prepared for classes. She concluded the lesson a few minutes before the buzzer sounded and allowed time for individuals to discuss personal questions with her thus showing that she valued keeping personal matters personal, and that it was not the business of the whole class to know why, for example, a certain student was going to be absent.

Tom uses a lot of humour in his introductory sequences thus telling the students that he thinks it is fun to be in his classes. He is friendly and engages in conversation with the students signifying that he is approachable. He spends the majority of his introductory comments explaining laboratory and project work and thus tells the students the high value that he places on these activities. He spends a considerable amount of time explaining the computation of marks and thus informs the students of the importance of this activity. Tom explains the nature of the courses that he teaches by posing questions similar to the ones he will use throughout his course. He builds a positive self-image of the class by praising the students and predicting that they will do well in his course. He continues to work on the development of self-esteem throughout the course.

Thus, during the first day of classes the teacher, by his/her actions and discourse reveals a great deal about the elements of the functional paradigm that guides that particular teacher for the paradigm is the teaching.

Major Findings

The following five points summarize the major findings concerning teachers' functional paradigms:

1. Functional paradigms exist and can be described in ways that reveal why teachers function in particular ways in the classroom. Similar to Kuhn's (1970) description of how a research scientist is guided by a paradigm, teachers appear to be guided by certain beliefs, values, techniques, exemplars and routines. Argyris and Schon's (1974) concept of theories-in-use, which are operational theories of action, is supported by the evidence from this study.
2. Common elements are present but different emphases are given to the elements of the functional paradigm by the teacher participants giving the appearance of different paradigms. Teachers are knowledgeable in dealing with situations as they arise in their classrooms to ensure success. The development of a particular instructional sequence or lesson plan (Shulman, 1987) depends upon the teacher's ability to transform his/her understanding of subject matter into appropriate representative analogies, demonstrations or laboratory exercises that will bring about student understanding of the subject matter. Selection of an instructional technique to bring about student understanding of the representative idea follows. Within this selection the teacher tailors the plan according to the general and specific characteristics of the particular class of students and to individual students. The actual instruction is followed by evaluation of student understanding and of the teaching. The teacher then adjusts any of the previous steps in light of this new comprehension. The teacher's

understanding of the subject matter seems to be influenced by academic background of the teacher (Lantz, 1984) and by the data from this study. The teacher's repertoire of instructional techniques appears to be influenced by the perspective that the teacher has concerning the role of the teacher and what is important to teach. These ways of knowing have common characteristics with other teachers but also have differences which make them unique. (Olson, 1981; Schon, 1983; Elbaz, 1983; Clandinin, 1986).

3. Varying degrees of consistency were discovered between the espoused statements about classroom functioning and observed classroom functioning. Congruence, according to Argyris and Schon (1974), means that one's espoused theory matches his or her theory-in-use, that is, one's behaviour matches what one says about one's behaviour. A complementary meaning of congruence is to allow inner feelings to be expressed in actions. If elements of functional paradigms are tacit, then uncovering inconsistencies can lead to a greater congruence over time and a possible improvement in the teaching practice of that teacher. It is through revelation of such inconsistencies that teachers begin to reconstruct their own theories of teaching and learning and revise their classroom behaviours.

4. Functional paradigms appear to be based on factors that go beyond the curriculum of the day. For example, a study by Lantz (1984) indicates that the academic history of teachers seems to play a large part in the shaping of their functional paradigms. Lantz identified that training in chemistry was a strong influence on teacher interpretation of chemistry curriculum materials and this study seems to confirm this finding. Certain characteristics that were admired

in other teachers also seem to have influenced the teachers in this study as did differences in the perception of science. A study of the origins of functional paradigms would seem to be an important area of investigation.

5. The elements of the functional paradigm are present and are actively communicated to students during the introductory instructional sequences. The majority of the values, beliefs, techniques, exemplars and routines that are valued by the teacher are found to be present during the first day of instruction and are reinforced during subsequent classes. The importance of the planning of the introductory sequences is a vital aspect of teaching.

For Further Research

This study is an attempt to contribute to a better understanding of what teachers do in their classrooms and why they do it. If teachers have an understanding of why they do what they do, improvement and change in practice becomes a viable extension. The study suggests some areas of further research which would contribute to understanding functional paradigms:

1. Studies, such as the current one, could be used to explicate functional paradigms of teachers which could in turn be used to give teachers a better understanding of their practice and could be used to initiate improvement in practice. For example, in an informal conversation with Catherine after she had read my initial findings she said that she did not realize that she was that strict with her students. She thought she would try to "loosen-up".
2. Studies of functional paradigms in conditions of curriculum stability and

change could be undertaken to determine what happens to functional paradigms when curriculum changes are initiated. A study of this nature may help teachers to understand resistance to change and to cope more effectively with change.

3. A study could be initiated on how students relate to teachers' functional paradigms. This was a limitation that was imposed on this study and might provide a valuable added dimension to our knowledge about functional paradigms.

4. A study might be initiated to investigate the differences in emphasis between the functional paradigms of male and female science teachers. Such a study may contribute to an increased understanding of differences in teaching styles.

5. A study might be initiated which investigates the origins of functional paradigms. Knowledge of origins and their development may be very important in the development of pre-service education courses.

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APPENDIX A

APPENDIX A-1

PERMISSION TO AUDIO-TAPE CLASSROOM INTERACTION

Department of Secondary Education
Room 338, Education Building, South
University of Alberta
Edmonton, Alberta T6G 2G5

September 8, 1987

Dear Parents:

RE: PERMISSION TO AUDIO-TAPE STUDENT-TEACHER INTERACTIONS IN THE
CLASSROOM

I am a biology teacher presently enrolled in a masters program in Education at the University of Alberta. From September to February, I will be gathering data for my thesis research. I will be working with(teacher name)..... as well as several other teachers in the Edmonton area.

The education process is fundamentally some model of teaching and learning. These dual activities of teaching and learning involve some shared interaction of the teacher and student with the curriculum in an appropriate environment. The influence of the teacher on student outcome is therefore the result of the interpretation of curriculum materials by the teacher and student, the teaching strategies and techniques utilized, the teaching and learning situation or milieu, and the students' background, attitude and behavior. My research is attempting to discern why classrooms function as they do. In order to gain insight into why the classroom functions as it does, it is essential to focus on the teachers, how they teach, and why they teach as they do. To aid me in this endeavour it is necessary to record on audio-tape cassettes the interactions between the students and teacher. Your kind permission is required in order for me to do this.

On the following page is a release form which I would appreciate if you would fill out and return to(teacher name) as soon as possible. Alternately, if you DO NOT wish to have your son or daughter tape recorded in classroom interaction please fill out the alternate section and return the form. In any case, your wish will be respected.

Thanking you in advance for your cooperation and permission.

Sincerely,

Cheryle Kachman

7

RELEASE FORM

With full consent I hereby authorize Cheryle Kachman and the University of Alberta - Faculty of Education - to make and reproduce audio recordings of my son or daughter as they relate to his or her biology classes.

I acknowledge that all such recordings are the sole property of Cheryle Kachman and the University of Alberta for the purpose of completing the Masters Thesis in Education as well as any educational purposes that may be deemed useful.

In signing this form, I hereby release Cheryle Kachman, the University of Alberta, its representatives and all successors and assigns from any and all liability, demand or damage claims of every nature and kind arising out of or connected in any way with these recordings.

NAME OF STUDENT: _____

SIGNATURE OF PARENT: _____

DATE: _____

I DO NOT WISH THAT MY SON OR DAUGHTER PARTICIPATE IN THIS RESEARCH.

SIGNATURE OF PARENT: _____

DATE: _____

APPENDIX A-2

QUESTIONNAIRE OUTLINE FOR PERSONAL AND ACADEMIC HISTORY

What is your complete name?

How old are you?

How many years did you attend university?

Where did you go to university?

What degrees do you hold?

How many years have you taught?

How many years were in an urban setting? rural setting?

What subjects have you taught during your career?

What was the last course that you took and when was it taken?

How many years have you been in the present school?

What professional organizations do you belong to? What committees have you served on or are presently a member of?

Are you married?

Do you have children?

What religious affiliations do you have?

How do you stay current with changes in biology?

Have you ever worked as a scientist?

APPENDIX A-3

OBSERVATION SHEET OF CLASSROOM SETTING

Observation Sheet

The classroom/lab

1. Main features:
2. Windows:
3. Blackboards:
4. Tackboards:
5. AV equipment:
6. Special equipment:
7. Shelves and cupboards:
8. Wall charts:
9. Posters:
10. Desks:
11. Clippings:
12. Other:

APPENDIX A-4

INTERVIEW QUESTIONS WITH PRINCIPALS

1. What is the population of your school?
2. What kind of a community do you draw from?
3. How old is the school?
4. How many teachers do you have in the school? How many support staff are there?
5. Describe the socio-economic status of the majority of the families whose children attend the school.
6. Do you have any significant minorities and if so what are they?
7. How would you describe your school?
8. What is your philosophy of education?
9. How do you go about setting the tone for your school?
10. What do you think the "heart" of the school is?
11. What do you advertize as the strong points of your school?
12. How many years have you been a principal?
13. You have previously indicated that this was a community school. What does this mean to you?

APPENDIX B

APPENDIX B-1

INTERVIEW GUIDELINE QUESTIONS - CATHERINE

INTERVIEW I

1. Why did you become a teacher?
2. What is your philosophy of education?
3. What do you value most in teaching?
4. What do you think the "heart" of biology is?
5. What is the nature of effective biology teaching?
6. What kind of a person do you see yourself as?
7. What kind of a student were you?
8. What are your priorities in life?
9. How do you balance your commitments?
10. Recently the term "supermom" has come into our lifestyle. What does it mean to you and do you think you are one?
11. Think of one or two of your teachers. What characteristics did they have that you admired?
12. What are some desirable characteristics of a "good student"? a "bad student"?
13. In what kind of learning environment do you think the best teaching/learning occurs?
14. Is there something wrong with education today?
15. Why are some kids illiterate?
16. What do you use as the main determinant of course content, way of instruction and evaluation in the courses that you teach?

INTERVIEW II

1. What aids do you use to determine course content?
2. Why do you have your students do laboratory exercises?
3. Approximately how many laboratory exercises do the students do in Biology 10X? in Biology 30?
4. Do different biology teachers in this school vary this number of lab exercises?
5. Why do you vary the things that you do during a 64-minute period? For example, you lecture for a bit, give an assignment sheet or go over something from a homework assignment.
6. Do you think your administration is supportive of what you do?
7. Your dress is immaculate. Why do you dress up for school?
8. Do you try to be an example for students?
9. You give assignments for homework. Why do you think that is important?
10. Do you check to see whether homework assignments are done?
11. Do the students do homework?
12. You seem to be very good at checking things out for students when you say you will. Why do you feel that is important?

INTERVIEW III

1. ____ tried to give you a bit of a bad time when you had commented on the use of "naked pronouns" in conjunction with the microscope questions. I got the impression that she thought you were "picky". Are you? Why or why not?
2. I noticed that you often do not give answers when they are things the students should observe in class or topics students will cover in a unit down the road. Why not?
3. You do a lot of explaining using diagrams which you draw on the board. Why?
4. Do you generally have a lot of interruptions during class? (How do you feel about interruptions?)
5. You approved of the Biology 30s having "munchies"-as you expressed it- in class. Why?
6. You use a lot of handouts. Why do you like to use handouts?
7. You work during your noon hours almost as if they were another class. Why?
8. Do you allow students to leave class for an emergency (i.e., a bathroom break) without permission? How do the students know this? Why do you not require permission?
9. Why do you use filmstrip/audio presentations?
10. Who has to put away handouts that were not utilized? What is your responsibility in this regard?
11. Why was that osmosis experiment a demonstration rather than a laboratory?
12. What is your policy concerning lates?
13. How do you think days when your son does not want to go to day care affect your teaching?
14. In the Biology 30 laboratory you did not give the students the colour changes that they could expect in advance. Why not?

INTERVIEW IV

1. I would like to explore the relationship of authority and being a female with you. For example, do you think ____'s chippiness is due to her challenge of your authority as a teacher? Would she behave differently if (name of male teacher) was her teacher?
2. Because you are female and "females pick up" do you think that you end up with extra work and duties in the department? How do you deal with this (depends on answer)?
3. Are there times when you are not given credit for things that are subsumed under the name of the biology department?
4. You spoke of "getting along with people" as one of your priorities in one of our earlier talks. Does this mean that you do more than your share so that you can "keep peace" with your colleagues?
5. How do you maintain your authority?
6. How do you enhance your authority?
7. How do you get your "strokes" in teaching as a teacher?
8. People seem to go to you as an "authority" rather than others. How do you view that?
9. Teachers are "gate-keepers". They determine whether Johnnie goes on and whether Sammy repeats the course. How do you feel about this function? Are

you comfortable with it?

10. How do you view diploma exams and IB exams?
11. Is a high average by the students on external exams important to you? Why?
12. What do you think identifies you as the biology teacher in the school?
13. In your role as "teacher" which accomplishments are you most proud of?
14. What are some indicators of successful teaching?
15. I was very excited about the development of the Valley Zoo field trip. You had to scramble to prepare extra materials, go on the preparatory trip, collect money, prepare parent release forms, etc. Why was it important to go?
16. Where do field trips fit into your philosophy of teaching?
17. In your view was the trip worthwhile? Why?
18. You seemed excited about the Heart Health Expo field trip. Are field trips important to you?
19. You often use the students' answers or something they do as a focus in your teaching. Why?
20. What do you draw on to deal with problems that develop?
21. I noticed that in the course of a unit you try to get the exams marked as quickly as possible. In fact in the time I observed you got the marks back the next day. Do you have a personal rule as to how quickly you get them back? Why?
22. What is the difference between a quiz and an exam? What is the purpose of each?

APPENDIX B-2

FIRST INTERVIEW WITH CATHERINE, SEPTEMBER 16, 1987

I: What I would like to do today is just some general things. General things about how you feel and what you think about. Eventually I want to take certain instances out of your class and ask "Why did you do this?" but to start this I thought I would ask some general things. And to begin with I guess the basic kind of question is "Why did you become a teacher?"

C: Coming out of high school, well not even out of high school, actually in grade twelve when students begin to think about what it is that they should be doing after high school I had always been very happy at school. I had always enjoyed it and done reasonably well. I always felt that I could have done better but I was the kind of person that I really enjoyed the social life of high school I wanted to have good marks and I would do the cramming technique the night before the exam. Worked really hard and then do fairly well on the exam. Not an honours student but just average, just an average student. I have always had a really good positive experience. Especially in high school. High school was really good and was probably one of the best. University also. I thought "What's wrong with staying in school as a teacher?" You have an environment you can enjoy. I enjoy high school. I enjoy high school students. I hope that when I am older I will also enjoy it. I have to say that the holidays attracted me. I enjoyed summer and summer activities. I thought that that would certainly be something that would draw to a career. A lot of the kind of selfish things that really attracted me to teaching in the first place, initially. And I enjoyed science and I enjoyed particularly biology and I knew that I wanted to go to University. There was no pressure from my parents but I knew that I wanted to go to University. And science seemed like ... I was going to teach biology and I like biology. When I was younger I always wanted to have something to do with animals. Sometimes people go through - I want to be a vet. I want to help animals. - They have this real love for animals and I think that is why biology .. I was interested in going on and taking zoology, pursuing it and using that to become an educator.

I: Did anyone ever suggest to you that you should become a teacher?

C: No. Not that I can remember.

I: So it was a decision upon yourself?

C: Yes. I actually had that planned out right from starting from first starting University. I know I knew that I would take my four years of science and then I would go into education. I would become a teacher. So I never changed my mind. I just decided that this is what I was going to do and I carried it through. There were a few times the first couple of years when .. especially the first year .. when I wasn't ready for university life. I tried to apply my high school study techniques and THEY DON'T WORK! and I had some failures. And I had some pretty traumatic experiences. And after the first year I really seriously thought about quitting and going to NAIT or something and I thought that University wasn't for me but I continued on and every year got better. And then I was sure, really sure, that I was going to continue on.

I: Sounds like my own life! That first year.

C: It was awful. I failed. I failed a course and I barely passed another one. And it was just a real learning experience. I would say everyone should go into university at least the first year. Well not everybody. Of course not everybody has the desire and capability but..And then you have to stick it out even if you fail. Try it another year! I would really encourage because it made such a difference. I just think..

I: It is just like night and day isn't it?

C: It is.

I: And I don't know what happens to you. But you get that final report card...

C: You're not sure or you .. I enjoyed high school but I'd say University was a real learning experience. I really enjoyed it and I'd go back anytime.

I: Oh yeah! Me too!

C: I'd like to go back.

I: That's like with me. There was no pushing me! I knew that this would be my last chance though and I have to admit that I had a terrible year. It was so hard. I loved everyone of those classes. It was wonderful. Sometimes I felt really selfish. Having to admit that I really enjoyed those classes. But that made me work twice as hard at home with the kids and so on.

C: Yeah. Yeah.

I: What is your philosophy of education?

C: I believe that education should provide students with the means to become self sufficient. Not just in being able to get a job, but in being able to acquire information to be able to handle themselves in situations to provide them with role models - not just teachers but other students - you know beautiful role models, people that are good to one other, to work, to do the best that they can, they don't have to be really successful but to do the best that they can, to take seriously that they are going to do something and let's try to make it an effort. I don't think that university, I mean, high school is for learning details. I know that my students won't remember the little things that I taught them and nor should they have to remember those things. But if they know and they've learned when they do want that information how to go about getting it. I think that is the sort of thing that education should provide at least the high school education. Not specific details learning. And so from that I can see that a general program has a certain amount of appeal to me that they want to introduce. It's just the amount and kind of change that will affect my life scares me. But I think the program is valid. That's the sort of thing that kids should be learning in school. Just how to deal with one another and how to find the things that they want to know at any particular time in your life.

I: I think that you have probably answered my next question. That is, what do you value most in teaching?

C: I don't know if I ... really ... Do you mean? ... Like from my point of view? What do I think?

I: Oh yes! From your point of view.

C: I think that I value the contact. Mostly. Not just with students but with other people. When you are at home for a little while with a young one you really really miss that. I think it's terrific to work in a large ... a large institution because you do get a chance to meet so many people. I ... ah. I get a great deal of pleasure from students if I can help them or even if they can help me. the relationship - the interaction - between people when you get a little down and you are happy with what you are doing.

I: Let's take that one step further. What do you value in, I guess, the process of teaching? What do you value in trying to teach the students?

C: (Long pause) I think I am having trouble in grasping what you're ...

I: OK. For example, do you value in the teaching process that students learn to take good notes off the board? Or do you value that they learn how to ask questions? That kind of thing. What sorts of things might you value?

C: I think what I value the most is students being able to communicate. Even being shy individuals who never ask anything who you are never quite sure if they quite understand. Even if you question them, it's difficult to draw an answer. I think that when you see the kids are willing to give - to share - not only with you but with the rest of the class that is one of the things that I strive for. Sometimes it is so much easier to just lapse into the part when you are talking or writing and you don't really see what the kids ... what the kids are doing; what they're grasping. So I think I value the most is when I can get something back from them. When I can get them to share an idea. I know that they are thinking about something - everyone of them - if I could just draw that out of some of them. Especially the ones that are very shy. It is very difficult thing to do. And when you are successful there, it is a REAL success.

I: A wonderful feeling! Isn't it?

C: Yes it is!

I: I think I know what you are talking about.

C: You can get the other kids to talk any time about anything. That's no problem. But it's the ones that have the trouble, they are shy, that are just coming out. That's the ones that give me the greatest pleasure to teach.

I: That sort of goes along with your idea of communicating.

C: Yeah.

I: What do you think the "heart" of biology is? What is it that we can offer students through biology? What are the most important things?

C: Do you mean "Why do I think biology is important?"

I: To their lives. How does it fit in with this idea of communicating and the things that you value? What, from biology, are the most important ideas or concepts?

C: I think as I went through University, I just became more and more aware of how fantastic life is. What a fantastic thing! And if, as I now believe, - which came as a very slow process - that Life was "spontaneously generated" I guess and developed over a period of time just made it even more fantastic to me. That there were so many different kinds of organisms. It just seems to me that it is such an exciting science compared to Chemistry and Physics! It just seems that it has so much more to offer because we ourselves are a part of that. Part of that life and so to try and get ... That's why biology to me is so exciting and that's the heart of it - Trying to get students to see how they are a part of this. How fantastic it all is. Even though you may meet with some initial resistance and that's OK, it's going to be a slow process to change one's ideas if they are ever going to change. I guess just the ... Just the

I: Just the wonder of it all

C: Yeah! Just the wonder! That's the word I was looking for. Exactly.

I: You scare me a little! Because I think to me that's one of my important things. To me that's what biology is about. Just the wonder that everything has a place and how it all fits together and if you disturb one part of it, and it can only be a small part, you disturb the whole fabric. You know the ripple ... and to me that's what I would like to get across to my students too. It's just so wonderful and like you say Chemistry and Physics - oh god!

C: It's OK but ... and it is a huge task. You are so overwhelmed by it but you're overwhelmed because of the years and years of experience that you had not only in school but personal experience. And it's just a monumental task in trying to pass that ...

I: How do you go about in doing that?

C: Oh boy! Like I said ... I think that it is just a very slow process and it just takes time and you're just one small part.

I: How do you do it, though? In your classroom? How do you start that process? If it has not already been started, how do you go about initiating that spark?

C: Well I think I look for certain situations with individuals. I don't know if you can do it en mass in a group because you are just dealing with too many separate personalities that are in different places with regard with this wonder that you are trying to get across. And I look for individual situations where I can do that. For example, someone shows a fear of - Oh there is a bug crawling across - they had gone out and collected some

leaves or something like that and there is a bug crawling across the table and somebody is afraid of it or somebody wants to squash it - I think those little situations are where you start this. "You know that's not a green bug, look at it, it's fantastic!

I: His mother thinks he's gorgeous!

C: That's right. This is where you start and your kids want to crush something or kill something well geez this is biology and we're here to learn about living things, admire them, not to destroy. That's not what we load the course with ... to destroy, I mean look at what you are doing. I mean the power you have got over this little thing and I mean why you take a closer look at this little thing. Situations like that

I: Like the pirhanas. Just before we came here.

C: Like the pirhanas. Try to get kids to look at them in a different light if they are looking at them in a light that is not favorable to the admiration of living things. I find the reproduction in the Biology 30 you know it's great - I think that if they remember anything they're gonna remember that because they may never have ulcers or heart problems or anything like that but all of them are going to be involved in child birth. So this is one - Also a perfect topic where you can get them to admire the miracle of development of life though it is selfish in seeing it in our own children - but once they see that gee the way the human is in the reproductive process, development and birth and so on. It is so fantastic! How can they not help but apply it and say that lots of animals go through this and is it any less fantastic for a caterpillar or butterfly.

I: What kind of person do you see yourself as?

C: Well sometimes I would like to be certain things that I am not ... Basically I certainly feel that it is very important to get along with people. This doesn't mean giving in and doing things that I don't want to do. But giving and take. Sacrificing of (garbled and could not decipher)

I see myself as a very, ... fairly gentle person. Deep down inside I have become very tender. I cry at the worst shows at the worst possible films in school for example, the birthing film. There are some very touching scenes in there and I have to quickly wipe my eyes before I get up and talk about this film to the class. So I am very sensitive. Sometimes I can become very angry. I do have a temper and that is one of the things that I don't like about myself. And one of the things that I am working on - to control this temper. There is no need to get upset about certain things. Sometimes very anxious. About certain situations. I think with maturity that is becoming less and less worrisome. Because as you have more experience and you look back on them you realize "Why did I worry? There is nothing to worry about!" So that is some concepts of what I am. Very very anxious. Something that I am becoming a little more comfortable with in new situations and ...

I: Are you a perfectionist?

C: I would say not a ... I like organization. I like things to be done well. Perfect? Sometimes it is extremely time-consuming and I wonder if it is worth spending the time putting in that little bit - that little bit more - to make it perfect. I could have spent

that time doing something else. I like to do a good job - even better than good - I don't think that I ever reach the stage of perfection.

I: Would you describe yourself as a workaholic?

C: I'd say so. I'd say ... There are people probably that have a lot of talent and therefore don't have to work as hard. I think that I have an average amount of talent but that I do have to put in a lot of work.

I: You're also modest I think.

C: Oh no. No. I could see that in university too. I had to work very hard whereas somebody like my husband Tom. He is very intelligent. He doesn't have to work as hard. He grasps things very very easily. And I know that I am not in his category. And so I feel that by working, by making that little extra effort working, doing a lot of work and spending that time, again not to the point where it is perfect, but to the point where I am happy and comfortable with it. That's good.

I: What are your priorities in life?

C: Well. I think that they have changed. As you get older and as you have a family ... I have to say that ... my child, right now, is kinda the top - the top priority. I enjoy working and I don't want to give it up. I know that some people think that you can't be a good parent and go out working. You should be at home. But I don't believe that. Because I've been at home! And I think that you need a break. I think that you need to get away from your children in order to give your children so much more of who you are together with ... So I think that work is very important to me but it is not my number one priority. I use it because I enjoy it. It gives me something that is for me. It fulfills me, and myself being happy and useful, I guess, feeling that I am accomplishing something and that I am helping people to accomplish their goals. I feel so much ... I feel good about myself so how can I help but feel good with my children and with my husband. I think that my family is probably my number one priority. Sometimes they do get short-changed - that doesn't mean that you don't think of them as number one.

I: How do you go about balancing your commitments to your family? And when I say family I know that you have in-laws, your Mom and Dad, your husband, and your son and all of this and what other commitments you may have outside of school with your school work. Because biology is quite demanding.

C: Yes it is. Ahh ... I think again I am learning especially now since a family has been started. I have learned that I have got to cut down on other commitments. For example cheerleading. I was looking after the cheerleaders for six years in this school now and this year I said I can't afford to be spending time after school, on weekends, during holidays, you know with the cheerleaders. So I think one way is just remembering what your priorities are and saying "No, I can't do this. I have something else going. I don't have the time. I have to try to keep up with my family responsibilities and certainly keep up with my responsibilities in school because it's my job and I am being paid for that one thing." So I feel an obligation and those are two most important things that I should be looking after and anything that is outside of that I just look at it and decide if I

have the time and how much time does it need and if it takes a lot of time I know that I don't have and just ...

I: You don't find it difficult to say "NO" then?

C: I am getting better. It's hard at first.

I: It is a learning process.

C: Yup. It is. Again as you get older you value that time and do you want to be spending it doing something that you really are not keen on doing. Sometimes you do and you enjoy it and you say "Gee am I glad that I did say yes!" But that means that something else is ah is lost. You have given up something else in the process. And I think you just kinda have to make a decision and start to learn to say "no". It's hard.

I: Recently the term "supermom" sort of has come into our lifestyle and vocabulary. Can you define what it means for you and are you one?

C: No! I don't think ...

I: You don't want to define it!

C: *Teacher 1* might be a supermom. To be a supermom is somebody like her. Although she doesn't have any children I know that she would fit into that category. I can already see that *Teacher 1* has ... she is tireless. She has endless energy. I never see her tired or down. She is occasionally sick but ... she is go go go! She never slows down. As a matter of fact even when she is relaxing she is doing something. You know that's the - that is the kind of person that I think could have children and keep on going at the same pace. She is going ... wouldn't slow her down any. That any. So I think that real supermoms that do fulfill all the family needs, cook - have time to cook the meals, have time to take the kids out and hold down a job, keep the house neat. That has got to be somebody with endless energy. That's like *Teacher 1*. That's not like me. I get tired. I need some time.

I: Private time?

C: Yeah. Private time. And I don't feel the need to be going. Ah ... full speed ahead all the time. And *Teacher 1* if you watch her a little bit you'll realize that that is the kind of person she is. She is always thinking ahead. Preparation is nothing for supermoms. Someone who is always prepared for something that may come up in the future and that's *Teacher 1*. Always thinking ahead. Always talking about "Well when are you doing this and when are you doing that?" two or three weeks down the road. I'm "My God! What about tomorrow?" So you know I don't think I'm a supermom. You watch *Teacher 1*. You'll get a kick out of her. She is great. She is a good person to have around because she keeps us organized. And if something is wrong she tells you that it's wrong. Some people find her quite abrasive but I don't. I think it is kinda good that there is somebody to say "Hey! Let's shape up here. We're slipping!" You know that's the kind of person a supermom is ...

I: I am going to ask you to I guess think back throughout the teachers that you have had and I'd like you to think perhaps about some of the characteristics that you might have admired in them and I'd like you to identify what some of these characteristics might have been.

C: OK. Well if I have to be perfectly honest at the risk of embarrassing you, ..., I think that you were one of the people that one of the first teachers ... No, it's true ... at *School 1* that I did feel an attraction to. I liked your ... You came across very self-confident in the classroom, very knowledgeable, and I think when I started to think about teaching biology I thought about you. I thought about the characteristics that you had. Very professional and I thought that was a very important feature or characteristic that I thought that I should have as a biology teacher. Ah ... another one was *Teacher 2*. He had the capability to kinda spellbind his students when he taught the history. I can remember just sitting there listening - just listening to him and it wasn't, you know, it wasn't infatuation or anything like that with *Teacher 2*. It was with what ... with how he said it. With what he was saying and how he said it. And I felt that was something that made it really enjoyable to be in his class. Plus the fact that he related very well to the students. *Teacher 3*. Who taught language was another one. Although I wasn't that ... I didn't have that much admiration for him in the classroom. In other words that's not where I really saw ... saw him. I didn't see him till after he had taught me. And his warmth and his friendliness and just so outgoing and mingling with the students. He wasn't upstairs in the staffroom. He was in the hallways and in his room. You could always find him to talk to. I admired that. You know that different teachers had different qualities that ... in a way some of the stricter teachers - you know, like really strict - I admired also because they didn't take anything - any guff - from any of the kids. So in a way I admire a certain amount of strictness in that the student doesn't pull the wool over your eyes. You know telling you things that aren't true. So I always ... somebody like *Teacher 4* while he instilled the fear of God into kids and I ... you wonder if that is something to admire, something scaring people. But I think it kept kids knowing ... kept students knowing ... where they stood and what you could ... what you could do. What was proper and what was not proper. So in a way I admire that although less than the other - the other characteristics. Still I feel that it is important to stay on top of students things like attendance and just make sure that they are doing what they are telling you that they are doing. And confronting them if they are not.

I: Can you give me some desirable characteristics of a good student?

C: Doesn't have to be smart. A lot of people want a lot of smart kids. That's nice. I would say somebody who tries. Students who try ... who ... by trying - personal unseen kind of trying - or it can be somebody who comes and asks you lots of questions and is very obviously working ... working hard. Friendliness. Kids who seem to want to be there. Not just gotta get this stupid course so I ... So kids who seem to basically enjoy ... enjoy life ... enjoy the situation they're in instead of hating it. I like courteousness. I don't mind if people tell me, "Well you're wrong. That's wrong!" As long as ... It's the manner in which they do it. So it's ... I am much more apt to agree with the student who comes across and tells me diplomatically as he can that gee perhaps you should change your mind on this because ... So courteousness. I don't mind kids that are talkative. In a nice sort of way. Not because they are trying to create a disturbance but just because they are just generally bubbly, enthusiastic people and they just gotta talk to somebody.

I don't mind. I think that is good and I think kids that are able to communicate freely with one another and that. That's ... I admire that characteristic. Although, I feel for kids that can't. That are very very shy even though they might be perfectly happy being that way but ... It's not a characteristic that I admire. Shyness.

I: What about some bad characteristics? Characteristics that illustrate a bad student for you.

C: I think students that are very wrapped up in themselves and have no time to see anybody else. They are so concerned with being the centre of attention. I have not really come across a lot of bad ... Usually when you think of students' characteristics that you really don't like ... combatant type of students, although those are very rare. But there are some kids who have fought back. You have made a decision and they have just fought that decision to the point of becoming so angry that the whole thing is just blown out of proportion so I guess kids with violent kinds of tempers and dispositions that I do mind. You can expect some of them getting angry perhaps a bit over (could not decipher what was said) Some kids are very ... The violent characters to grate on. As soon as something doesn't go their way they find it difficult to go on.

I: What kind of learning environment do you think the best teaching/learning occurs in?

C: Well I would say that an environment involving a small group of people. I found in my own experience the best way to learn something is to teach it. And if we can have a small enough group so that every student ... you could get every student to try to teach you what they thought they had learned then I think that's the absolute best environment for learning the most in the shortest amount of time. When you have classes of 35 or more kids then I think that really the kids are almost on their own. They are expected to grasp it through lectures, films, books and so on and very few will come to you and you have to go to them and I think it is the least conducive. I think it is good for kids that grasp things very easily and challenges kids. But the ones that are just average or potential failures in the course it is the worst situation for them (faded away)

I: Is there something wrong with education today? All this illiteracy stuff that has been coming out in the newspaper in that Southam research. Is there something wrong with education today?

C: Boy, reading the newspapers, you sure wonder.

I: Why are kids illiterate?

C: I have met very few kids in my classes that I would consider illiterate. I mean some of them the grammar is not as good and obviously they have difficulty writing. I mean you are talking about one or two people in the classroom so when I read about these statistics in the newspaper I really ... I don't see it because it is not happening where I am teaching. I don't feel that we have the problems here. Although we can have ... Canada as a whole. There are many situations where the education of students maybe is not ... is not as good. We are talking about people from such diverse backgrounds who don't have the opportunities. I mean we are a middle class high school here so of course I don't see anything wrong with the education here but you know maybe go someplace

where education isn't considered as important in the family. Well how can those kids really be successful in school when they don't value education so I don't know whether you can say that education is failing them. I think that certainly things could be improved for them but I think the desire to become literate and so on has to be there and you can't force that sort of thing. So I would say that overall I think we are looking pretty good. In different situations it is difficult to say that. Obviously education is not that successful for certain groups of people. As far as I can see at my school we are doing alright.

I: Our time is getting a little bit low. I'll leave some of these questions for another time. Are teachers born or can you produce a teacher through the teacher education programs at the university?

C: Well I tend to lean towards born. I think that there are certain skills that people come into university with and I can't remember learning those skills in university. I can remember learning certain techniques, procedures to enhance those skills. But I do think that there is something in the make-up of certain people that make them good teachers. So I tend to lean towards the born although not completely. I think that one does have to have the training.

I: The enhancement?

C: The enhancement, right. When I was first going to university that's what I first thought. Well this is silly! To take these education courses because you need a good teacher and you can't teach it. So simple and naive. It was a young way to view things. And I don't do it anymore. I look back on some of my courses and I think "Yahh ... That's very interesting and it's something that I can use." I see now what was being stressed here. Although I still think that a certain amount of skill is involved in teaching that must already be there in the person and that sort of thing cannot be taught.

END OF INTERVIEW 1

APPENDIX B-3

SECOND INTERVIEW WITH CATHERINE, SEPTEMBER 23, 1987

I: There are several things that I wanted to talk to you about. Some of them are general; some of them are specific; some of them are personal. If you don't want to answer just say, "That's it, I'm not answering!" Very general question, "What sort of things or aids do you use to determine your course content?" For example, you did scanning microscope, electron microscope and you did a comparison. Now that may be in the IB curriculum, I don't know but it certainly isn't in the Alberta one. What sort of things do you use to determine what you teach that is different actually?

C: As far as the IB courses go we do have an IB curriculum and especially at the beginning we used that a lot. You know, I mean right next to you all the time.

I: But that's not cast in stone. As long as you cover it within the three years it does not matter where you cover it.

C: That's right. Exactly. That's the most confusing, especially for the kids. We give them a copy of that curriculum and things are spread out all over the place. They haven't got it organized the way we have organized the 10/20/30. So as far as the IB goes I mean that curricular information was very important. I have really relied a lot on those units that have been done by people like yourself in the past, and *Teacher 5* when I was at *School 2* for one year. It was so helpful. That was actually my first year of an entire year being responsible for a class. It was so helpful.

I: He has fond memories too.

C: So it really helped to focus in on what you had to cover and then in later years as you branched out and as you did more reading on your own and some of the other kind of things are just interest kinds of things. Things that you know the kids are going to respond to and you tend to put those kind of things in. You don't necessarily have to be tested. I really feel that the AV materials ... there are some really good things available especially those filmstrips and slide-tape presentations and sometimes they'll ... you know, they'll cover the curriculum quite well. They have a lot of extra material as well but if it is interesting we'll dwell on that and cover that ... take a little more time in class.

I: Do you rely on the textbooks? Fairly heavily?

C: I don't really read the chapters from cover to cover especially not any more. I think that I did in the beginning. When Kimball came out, I'd read the whole chapter and that is what I would base my notes on. Now when I even look back on my notes I think "My god! What I expected the kids to know or even what I mentioned in class is just" ... I would never talk about this in class now. It is just not ... It's really not important and they are going to be reading about it anyway so why talk about it in class too. Why not talk about the things that they want to talk about, curricular materials, and what you do have

to cover. That is the kind of thing that is important to talk about and mention in class. But now I just use the book as a kind of reference if I want to clarify a point, if I want to refresh my memory but I don't read the whole thing from cover to cover. If there is a section that I feel, Gee, I haven't done this for a long time I better look it over and see what the textbook says or if the kids ask me something or there is a possible error or the kids are confused about a section then I'll look. I don't go back and read the textbook cover to cover, I am familiar with the textbook now but I certainly haven't read it from beginning to end. So films, a lot of AV material and now we are starting to use oral reports and the disease topic lends itself so well to ...

I: I like that assignment.

C: Yeah! And the kids can pick whatever they want. And it's something that they are interested in and yet it relates to the curriculum. It may not exactly be in the curriculum and I don't restrict them to having to cover a particular disorder that might appear on an exam but whatever interests them as long as it relates to what we have been doing in class. I'm happy with that and so ... And I'll answer any questions. Try to answer them as they arise unless or at least try to answer the question generally and say "You'll understand better. We'll go into more depth later on." So I do try to let the students kinda guide the class a little bit in that way. I don't believe in shutting questions off and saying "We haven't got time to talk about that. Or we'll talk about that next week." If something comes up they're obviously interested now and we have to at least address the question.

I: Those kinds of things (interruption by PA) were something that I was going to ask you about. Do you often have interruptions? Yesterday you made the comment that "I must have done something wrong!" Do you often have interruptions like that?

C: No! I think it seems to come in threes. Ya! In groups! The telephone rings and somebody is late at the door and somebody else has to leave or talk to you or something like that. Some days are like that. PA announcements are infrequent. Usually only once a day in the morning at a set time. And you do get occasional interruptions like that. Usually doesn't happen once a day and .. and rarely do they put through calls to the classroom unless they know it is an important call.. a long distance call or something like that then they will put it through. Which is fine by me because it is pretty hard to talk there anyway.

I: I know because you have to go outside.

C: Well ya because the kids start talking. And actually with thirty of them in there what are they supposed to do? They start talking and actually I would rather have them talking quietly than listening to me on the phone. I don't mind and try to blot some of the noise while I'm walking around towards the door there because the conversations are quite short.

I: On to more serious things. You do labs. Why do you do labs?

C: Well I think it.. We try to get the labs to reinforce what has been done in the classroom or to introduce material usually what is happening is we do it not to introduce

concepts so much as to reinforce concepts that they are already aware of. That is something that I would like to work on. Maybe have some of the labs come first and then learn about what was done in the lab later on. That is a hard thing to do and it would involve quite a bit of reorganization and just rethinking our whole teaching process. So of course to supplement the material in the curriculum, good hands on.. I think the kids enjoy .. enjoy actually working with the chemicals, the organs that we are talking about. I know that a lot of them are apprehensive at first or at least they let you believe that they are apprehensive at first and that they don't enjoy it but most of them go out of the lab very up..very happy about what has been accomplished and so.. It's a nice break too, gets you out from the front of the class and gets them doing something and actively participating instead of listening to someone discussing and I try to involve them in the discussion..

I: How many labs do you do approximately? In Biology 30?

C: Somewhere between 10 and 12. In ten also close to 8 to 10 labs.

I: At this school do all the teachers do the same labs? Or do you choose your own and others will do slightly different ones?

C: I think that we all do pretty much the same labs.

I: The same and the same number?

C: Very similar very close or at least the Biology 30. The 30 teachers always get together and because these labs are so time-consuming to set up and because material has to be ordered in you really do have to plan for all of the teachers to do the lab and there really is no advantage I think to having different labs selected by different teachers. First of all there aren't that many.. well there are lots of different labs to do but you know there are the standard ones which pretty well everybody.. everyone does and *Laboratory Assistant 1*, too, goes to a lot of trouble to set up the labs and they have been worked through and we have tried to modify and fix them up and so on. You know there is lots of years of improving labs and most people at least who come in are very happy to do the same sorts of labs and then help us to make any changes that are necessary. You don't really get very many people that are interested in, at *School 1* that I found, that want to do totally their own thing that don't want to do any necessarily the same labs as another. Plus you are controlled to some degree for example in Biology 10 you have to do dissections - the earthworm dissection, the crayfish and the frog - so there are the mandatory type labs that you feel that you should do because it is directed by the curriculum.

I: You did an osmosis demonstration. Why didn't you do that as a lab?

C: Why, I think first of all, that we already do so many labs plus the time that is involved in that particular section, that unit on biochemistry is a long one. Already with the carbohydrates lab, the protein identification lab plus the enzymes lab that would be five labs then if we added this osmosis lab to it. I think that is quite a few labs to be doing in one month. Plus really all the kids would be doing is setting up their own their particular demo and that would be fairly time consuming to have each group setting up

their own and would certainly take the better part of a period just to set up their own apparatus plus no guarantee of any kind of success with that lab sometimes we don't .. we are just ironing out the bugs out of it ourselves so. I think because it can so easily be done as a demo and there are already so many labs in that section of the course. It is nice.. I would prefer you know.. This is the only demo, really, that we do in the course. We don't do any other demos in the course, everything else the kids do so ..

I: I like the way you.. one of the questions.. Why is this a demo rather than a lab exercise? I thought maybe that was one of your main purposes. Cause that just tied that together so neatly for me as an observer. I thought, " Wow that is a wonderful way of doing it!"

C: A lab doesn't..when you say "do a lab", I don't necessarily think of an experiment with the controls and so on although it could very well be that demo.. there would be nothing to.. there would be no problem with that.

I: Are most of your labs.. You have chosen them so that it's pretty well guaranteed good results?

C: Not initially! Lots of things go wrong. At this point we have tried to refine the labs so that at least you get fairly reliable results.. at least some part.. you have some success in some part of the lab. You can see yourself in the last part of the last lab.. mistakes will be made. Kids will put the wrong solution in and so on. You can't guarantee success really in a lab. You can just set it up so that things are straightforward so that there is a good chance that things are going to work out right for the students especially if you are going to take the lab in and you are going to mark them on.. you are looking at their results to indicate how well they have done the lab, did they understand what they were doing and have they set things up properly and I would feel that it's not fair to mark them on that basis if the lab isn't well organized and can't be guaranteed of some.. that the chemicals don't work properly that there isn't any contamination right away to start with and so on. Well this lab .. I think the biochemistry labs are the worst ones for things going wrong because there are just so many variables and you have to keep on working with another group's test tubes from the previous lab and with their washing techniques ..was their.. just their whole lab skills come into play that lots of things can still go wrong.

I: If anything can go wrong it will!

C: Just adding that Biuret solution instead of Benedict's. I mean what more can you do except stand over the student and say "No, no, no this is the stuff that you add. Not that. This!"

I: I had watched them! They had both bottles. Gee is there any difference and they looked at them. No I guess not. And then they went ahead and I thought OK just let them do their thing!

C: I told my next class. I mean I had warned them about it. I thought well I'll try and prevent another group from doing that and we had a good laugh about it. You know, I said, "Look at this - Benedict's and Biuret. You know they both start with a "B"

but that's about all that is the same between those two words. And mind you the Biuret is just a little bit blue so you could get confused with Benedict's! I suppose" But it brought up about reading labels and it was a learning experience. Especially for those kids that did it and they wanted to go over and look at somebody else's results.

I: What did you do?

C: I said, No! No! you made the mistake and you go over. The girl tried to blame the guy that he put it in. Here's another opportunity - Partners working together! It is not one person's fault or the other person's fault, they are both responsible for the labs. Just do it again. Just to reinforce the idea that it is Benedict's that you are supposed to be adding and not Biuret. There is lots of opportunity when mistakes are made to correct them and to learn from them.

I: You vary things a lot in your class. Why do you do that?

C: I think to keep the kids and myself alert. It is just a variation on activities I think that the same thing holds true for really young kids when you have an attention span of a few minutes and then you have got to go on to something else. I think that is true for older students as well. You can't keep going. You can't keep lecturing. You know yourself when in university and you have hour and hour and a half lectures. They are long!

I: You just die!

C: They were long and you were exhausted by the end of them and you just went out of there in a daze. Varying activities, doing a demo, showing a slide-tape presentation or having them do some reading in a little section or reading some handouts or preparing for a lab just keeps us all from becoming bored.

I: Your dress is absolutely immaculate each day. Why do you dress up for school?

C: Makes me feel better! That's true. They say that if you feel awful what you have to do is get yourself cleaned up and dress yourself up nicely and it will just fix you up. I believe that is true and sometimes when you get up in the morning and you just don't feel like going to the trouble and that's why I think it will help me. I just feel and act much better if I am dressed better. Plus I do feel that I am a role model to the students although nowadays the students dress very well. It is not the same as when I went to school.

I: Everybody wore jeans then.

C: Yes.

I: I mean nobody dressed up. But not any more.

C: Now it is very much the opposite way. Kids dress up really nicely and..

I: The teachers are slob! (Much shared laughter here)

Technical difficulties here because of interference and a short segment of conversation missed.

C: the IB program and yet we can't get any money to sponser a field trip to Storyland Valley Zoo.

I: What's going on, hey?

C: Exactly!

I: And yet in talking with your principal, he is very proud of that IB program. It's a drawing card for having a population of 1200 at this school so it becomes very important.

C: It's not that it could be more of a drawing card. It is. A lot of people show up here and want to hear about the IB program. Students themselves from Grade 9 come to the school. A lot of people are interested in the program. But all those kids get right now is more work. More work than the other students. And some kids are smart. They see no advantage in the IB program.

I: I'd lose my social life..

C: They lose their social life. They don't join any teams because they haven't got the time to study. They.. I don't know they just.. *Student 1* is an example. He is here all the time. He spends his lunch hour working. A student like that deserves the little bit extra because he puts out so much..because he puts out so much extra so he deserves to get something back. I don't think that is asking too much. And some kids recognize that and are dropping out. They are not taking the full program. We are under pressure to keep students in the program and yet they don't see the benefit of taking the full program and are interested in taking one or two courses. So you lose a lot of people along the way. The extended essay is a big responsibility.

I: And the community service, too.

C: Exactly. The Theory of Knowledge course that they have to do. It's part of the requirement. And they have a lot of extra work with..

I: Unless of course the kid loves work.

C: I don't know. In that way I don't think that is truly supportive.

I: This business about.. This is not directly related to you but the school climate. Do you think your school is peculiar in that teachers do not want to participate in school affairs - school parties that sort of thing- staff cohesiveness or do you think that is true of other schools as well.

C: Oh I think that is true of other schools as well. Maybe not quite to the same degree.

I: Well how many staff in total do you have?

C: Fifty-five. Fifty to fifty-five.

I: Has the staff ever been really cohesive? Real party goers?

C: Not in the six years that I have been. Of course I am not one to be a party goer. So I.. it's a little bit difficult for me to comment on exactly how cohesive the party going group was initially. But I am sure right from the start there were certain people that never came to any parties. But I mean I go once in a while but it's not.. not a regular thing.

I: It's hard to coordinate such a big number.

C: Yes, it is. Especially when people have their own .. I mean once you're out of school and I just feel by the time I get home and that. I just want to spend some time with my son.

I: And sometimes I feel, and maybe I can get your feelings, but the way I feel is that I have put in my day and it's almost as if I go home to my special little haven. I just want to get away from it.

C: Yal

I: And if I have some school work that's fine and I tuck away in my study or whatever but I don't want to go back. I just don't want to go back. You know for a party or whatever.

C: Sometimes it's nice.

I: Oh ya! Well I know we had certain parties when I was teaching and there were certain ones that you did not miss. Our year-end party was absolutely a blast and we just had a terrific time. There was usually a good turnout and it was just.. it had a reputation and a tradition. And it was great. But some of our other things just didn't work out. Pause..

I think you have answered this one but I am going to ask it again. You try to be an example for students. You talked about a role model. It is the same question really.

C: Yah. I try. I tried to .. as situations come up I try to demonstrate or to mention what the appropriate thing to do would be. But sometimes I think people and not only young people but older people need to be reminded what's really the right thing to do even if you don't feel that that's what you want to do, what you care to do.

I: In other words a "No" deep down is really a "Yes".

C: Yes. So in that way and .. That's a very hard thing to do. I found that very difficult to be a role model. Cause you fall down so much yourself.

I: You are only human.

C: Yuh. You are not perfect and you make lots of mistakes and sometimes you lose your

temper. So how can you be a role model for being a patient understanding person when you lose your temper. So you know I make lots of mistakes but that's who I am. But every year I come back and I say to myself "This year these are the things that you are going to change." When a student comes to you a student that you know you're angry with because they have done something and you know that they know better and when are they going to take the responsibility and just try not to take the offensive with them. That's the worst thing I know for making somebody withdraw even further is when you become defensive and reprimanding about how they handled the situation that you feel was inappropriate. And just to let go of your feelings and just try to .. try to get them to explain why they did handle things a certain way and get them to see what is or might be a better way to handle the situation. That is a very difficult thing.

I: Boy, I'll say it is.

C: And that is something that I would like to be able to role model because that is .. It's an art! It's hard to learn and very few people can do it.

I: It sure is.

C: I get pretty angry at kids sometimes.

I: I have this temper too! And sometimes it gets the better of me. And then you feel so bad.

C: Yah, you do. You feel really bad after that. My god, you think, that was not, that was not the way to do it. Look all you have done is created animosity. Now you will never reach that person. It's hard.

I: You give assignments for homework. And I guess I have a series of things here. Why do you think it is important to give assignments for homework? Do you ever check to see whether it is done? And do the students actually do it?

C: Well..I give assignments because I do want students to do some work on their own. There often isn't time in the classroom to do all the reading they're supposed to be doing and we'd only get half-way through the course if they were doing all their reading in the classroom. I want them to be able to make some of their own notes and not take everything directly from the teacher in class. At least work on those things. I think this gives them a better chance to understand and see it presented three or four different ways by the teacher, by the book, by the film, by the slide-tape presentation, in the lab, the more different ways that you can present something the more, I think, the more.. the easier it is to retain. The ones that grasp it quite easily, the more opportunities (could not decipher last part of sentence) to learn. I think study habits are very important even if you don't go on in school. Just being able to sit down and if you're interested in some particular topic just to focus yourself and read a magazine or book or whatever. The more practice that you have the better. I do check to see whether they have got their assignments done on occasion. I do not do it on a regular basis but I do it on occasion. Especially when I am counting on them having their assignment done and they are not being responsible. Then I'll check. It feels like.. I feel like an elementary or grade school teacher walking around just seeing everybody's work.

I: Do you find that most of the time that they do it?

C: I find that initially that they do. And then as the year progresses it tends to slip. And that's usually when I start looking around towards the end of the year when I see it.

I: Have you ever found yourself reacting when you tend to do less in say review perhaps? You expect them to do a certain amount of stuff. How do you react yourself? Do you do less in class? So that they'll take on more responsibility or is there any reaction from you?

C: You mean after ...

I: After you find that they are not doing as much as they should be. How do you react?

C: Sometimes what I do is send the kids that haven't done their work up to the library while the rest of the kids that have done their work we discuss any problems that there might have been. Sometimes when I see an entire class hasn't done their work, that is their problem and here's the next assignment so here is their responsibility and we'll try again tomorrow. This set of objectives is your responsibility and if you have any problems come and see me individually and I'll be glad to go over. I won't spend class time lecturing completely material that they are partially responsible for. So sometimes I'll react that way. It depends on the situation too. If it is after say a certain event usually you try not to give them work anyway after grad, for example..

I: Special football game..

C: Yah, exactly. Then I take it easier. It's very short. Most kids are able to do it. But there's situations that come up where I'm .. just ask them in the future to do their reading and you just let them know about the benefits of having attempted these assignments themselves and how that prepares them to ask questions. Otherwise you just sit there and this is the first time they've heard everything. It's just not to their benefit. So you try to explain. Explain that. It depends on the situation and how many kids.. It depends on the classroom climate too. Are they bordering on out of control and there is just no point in going over the material because they're not..because their hearts aren't in it today.. so .. there are a lot of a list of values depending on the situation.

I: You are very good at doing the homework assignments they give you. And what I mean by that is that you are very good at checking out things that may come into a discussion that in class you are not sure about and you'll say "OK, I'm going to check it out!" I noticed that you are really good at that. You go and you check it and then you bring the information back. Why do you feel that's important?

C: Well partially for myself. I feel that if I don't know and this question has been brought up I would like to know too. If a student asks I'm interested in finding the answer as well. Actually perhaps I'm doing too much of that. Perhaps I should leave the responsibility with the student who asked the question to get the answer and report back to the class. I think that that could be done, for example, in my IB class. The only concern that I have in doing that is that kids will stop asking questions. Because they are

afraid that that will mean that they will have to look for the answer. Although kids that are really interested would go if they remembered. Will go and search for the answers. Once the question has been brought up I think that there are more people that are interested and have the same question but I have, like yourself, access to books and I know where to go to look for the information even if it is a bit complex and I try to make it so they can understand the information. There is a lot of kids and the kinds of routes that they have to go through to get the information is just so far beyond them that they really don't know the answer when they find it. So I try.

The first part of Interview II with Catherine was done during the noon break in a lab room that was supposed to be free. Conditions were not the best. Due to frequent interferences by teaching colleagues, students, and the PA system we decided to conclude the interview during a quiet time at a science conference a few days later. This we proceeded to do.

APPENDIX B-4

CONCLUSION OF SECOND INTERVIEW, OCTOBER 2, 1987

I: I guess we should go on with these questions that I had and see what happens. I was going to pick out some special situations in class that I noticed. One of the things that I am really intrigued by is *Student 2*. She has got a chip on her shoulder. Or at least that is how I viewed her. I am interested in how you're dealing with her. How do you deal with kids like that?

C: Oh boy! Right exactly at the beginning I think I told you that for the first day of classes I told them all what the consequences would be of a missed exam. And I just mentioned just generally not applying to any particular situations and then..sure enough..here comes the first exam *Student 2* is the first person who can't come and of course when a kid says to me "I can't come to the exam" or "I won't be here" I don't like to talk to them in front of the class because it is not their concern.

I: It's a personal thing.

C: It's a personal thing and in a way why did you bring that up like during the class. How come you didn't tell me before or after class? So right away I tell them you can come and talk to me personally after class. This isn't something that we have to discuss and hold everybody else up listening to why you can't come and write the exam. So I don't know whether that might have triggered it. Maybe I was a little bit abrupt with her. But once I did talk with her after class. In fact at the end of that class she came up to me and began to discuss it. She told me that it was because she was on the golfing team and so on. Well that's fine because to me it doesn't matter what the reason is. If the kid misses it for school-approved activity or because they're ill or whatever, they just write the make-up exam. And when *Student 2* came back with asking me about the make-up exam and asking me whether it was multiple choice and I says "No, it will be long answer" and I try.. She said.. Immediately I could feel this.. She said, "Are you trying to punish me by giving me this exam?" And that's when I realized about this chip on her shoulders. Seemed to be.. And of course I got her name wrong and I called her *Student 3* and she corrected me immediately so she has no bones about letting you know how she..expressing her opinion. But that is the first time a student has ever said to me "Are you trying to punish me?" and I explained that I don't give the same exam the next day to kids who missed and I don't have the time to make up a brand new multiple choice exam. They take up a long time to make up and I'm not about to do it because people miss it to play golf. So and I never even thought to say that I told you all this the first day of class so why are you surprized to hear it. And I think that I thought of more things I could have said to her to let her know that I was really quite upset. Upset about it..Are you trying to punish me? As if it was a personal attack on her when that is the policy that I have been following for years. It's got nothing to do with punishing one person it is just the policy that I've established and the school is now starting to seriously look at whether we should change our exam policy that kids are being allowed to write exams the day after, two days after, three days after..

I: The same exam?

C: The same exam. Now I'm not stupid and I went to high school too and I know that kids talk about exams.

I: You betcha.

C: You know they can even talk in between classes. You're even taking a risk having the same exam from your first period class to your last period class in the day. Those questions those kids are gonna know. What's being asked on that exam so I feel that the policy that I have established that kids who miss an exam simply write a make-up exam altogether and that way don't have any kind of an unfair advantage except maybe they have a little bit more time to study but I mean it's a written answer exam so I mean they should know their material thoroughly by then and shouldn't have any problems with written answers. They aren't tricky questions or anything like that. It's just that they have to know their materials without a lot of guess work involved. I could see that she had a bad chip.

I: How do you deal generally with kids with a chip? Or have you not run into very many.

C: Not that many. No. No. Not like that. But I think that *Student 2* is already starting to soften up. I found this last lab. I was able to joke with her a little bit. And she was a little bit.. like *Student 3* and *Student 2* were working together there and she was a little bit better.

I: I think that the two of them had a sort of synergistic effect on each other too didn't they?

C: Yuh. Yuh.

I: I don't know if they knew each other before.

C: Now with *Student 3* gone I don't exactly know what is going to happen with *Student 2*. Maybe it was the fact that she did very well on that exam. She got 39 out of 40 so I mean.. maybe she thought well geez she is obviously not trying to punish me cause I probably got a better mark than I would have off a multiple choice section because the questions were quite straightforward. There weren't any answers that were really close that could dissuade me I either knew the answer to the question or I didn't. So maybe that had a effect on her that she saw that this wasn't a tough hard exam designed to beat her into submission because she missed the exam due to golf. So I think she has come around and I think it's going to be OK during the.. I haven't had that situation occur too often and I know that if it is not resolved..boy it's hard. It's really hard because you always feel that there is that animosity between you and the kid and you almost go out of your way to avoid.. to avoid each other and I try not to..I try to be friendly and that and let the kid know that maybe we've had this disagreement but now is now and let's move on and not let it stand in our way. I would never try to punish *Student 2* or something like that for being so cold and aloof I guess.

I: When you handed back those microscope questions she thought that you were really picky. When you had corrected her on a "naked" pronoun. It's one of the questions and you didn't know what she was referring to..it was a question on the image. Do you recall? Anyway it was when you and she had a discussion and you didn't know whether it was the image or the specimen that she was moving.

C: She had used "it".

I: Right. She had used "it" and so you didn't know. She thought that you were really picky about this. Now that was really obvious to me. Do you think that you are a picky person?

C: No. I think it is more precise. I think language is very important and students have to learn that what it is that they write down on paper can be interpreted in more than one way. I mean a whole.. our whole.. Laws for example, cases are won and lost for example in court based on just language that's there and the interpretation that it's time that they learned that if they mean something that they had better be sure that they put it down precisely in that way because I'm not going to try to guess that what I understand that they mean is actually what they meant. It can be interpreted in more than one way. And I think that high school is the place to start. Getting out of junior high mentality as long as you just have the general kind of idea you don't have to worry about clarifying the thinking or making yourself clear. So as long as there is a.. If I read a question and I feel that it is vague I don't.. I feel it's vague, I don't know for sure what they meant I'll give them a part mark or no mark but not a full mark because I don't really understand that what I wanted was what they actually thought.

I: They come into line pretty good too by the time they reach Grade 12.

C: Sure. You have to do that right at the beginning and then that way they work on putting their ideas down so that other people can understand them. I mean it's a test that I'm marking, I'm marking their comprehension.

I: It is good practice for later life.

C: I think so. I think so. And you can't have any delusions about..

I: Going away..sort of moving away from this particular girl, one of the things that I noticed was that you often don't give answers when there are things that students are going to observe in class or there are topics that the students are going to cover a little bit further down the road. Why don't you give them answers?

C: I think that initially as a beginning teacher I did. You know thinking that my job was just to spout information and knowledge and the kids would just milk you for the knowledge. But actually I think it was ___ that first made me see why should you just make it easy - completely easy - so that the student doesn't have to do any thinking all they have to do is read the question and in two seconds decide that they don't know the answer and put up their hand and ask the teacher and know that they'll get the answer. I thought you know that's right. I mean why are we here? Are we here to be a textbook? You know for the student. They don't even have to read, you know, they just have to ask,

they don't even have to make the effort to look anything up! So that is when I thought "Yes!" I think part of the job is to teach them to think for themselves or if they are having trouble or at least supplemental to the actual thought or thinking through process and they don't have the background information, that is pretty hard to do. But they can always find the background information and then do some more thinking about it and chances are they will come up with the answer and remember it so much more because they did it themselves than if you just told them the answer. And other kids tell other kids the answer and what a lost opportunity for that kid to discover that ya they did know the answer and to boost their self-confidence and when it comes time to write the exam they are not worried that the questions will be so difficult that they have never done any thinking, any practice thinking and so I don't make it easy for them any more. I have let the kids struggle along a little bit and the more that they struggle the more hints that I give so eventually they can make some revelation by themselves even if it is a little tiny one because you have had to keep feeding them, hinting and guiding them along because.. eventually it will get better.

I: It was perfectly illustrated with *Student 4* and that noon hour lab during which she stayed. It was really neat to see that expression of joy on her face when she found it for herself.

C: Ya. Right!

I: Some of these questions, I already know the answer but I am going to ask you them anyway so that I will have a written confirmation eventually. And one of the things that I noticed is that you approved of the 30's having munchies in the class. And I would just like to know why you did that.

C: I approve of any grade - 10, 11, or 12 having munchies in class. I think that the time comes when you have to give them some adult privileges. And one of the adult privileges that I thought was really neat was to be able to take my coffee or whatever into the lab or lecture and like it was my responsibility to look after that. It wasn't such an authoritarian environment. And like I said as long as the kids respect the right to the next person to have a clean area to sit in. I don't mind that as long as it is not a disruption. Sometimes people are so busy too at lunch time and kids are no exception - they have busy lives too - and they don't get a chance to eat a proper meal and I don't want them sitting in class there thinking about food when you should be thinking about or doing in class. Let them bring or finish their lunch. I really have not had any problems. There have been the occasional messes that are left but I can't say that eating or drinking anything has proved to be disruptive. I just think that they should be accorded those kind of adult privileges. They don't abuse them as far as I have been able to see and especially after lunch and kids never had the chance to eat their lunch and now they are hungry and eat it in class.

I: I noticed that your football players often bring drinks and some lunch. Like *Student 5* and those kids over there. When I saw that and I watched it over a period of time, I thought that sorta showed your humanistic side. Do you feel that you are quite a humanistic teacher? Caring for the students?

C: If I am, I am not really aware of it because you know I don't really know if anybody

really eats lunch. Like I don't really see it anymore! Because it doesn't bother me if they do and it doesn't bother me if they don't. So I know that I would like to be considered humanistic but I don't think that I go out of my way to do anything special to try and make.. Sometimes I think some things just come instantaneously and I don't give it a thought as to what is the right thing to do here.

I: Just do it.

C: That's right. I just bark out that this should be done. And that's it. I don't think about whether this is a good thing or this is a bad thing. Maybe later on I see that that was wrong.. wrong thing to say or the wrong thing to do but I think that as you get older too, you get a little more lax. When you first start out you're afraid. You've got to set down all these rules.

I: You've got to be in control?

C: You've got to be in control and as you get older you realize you're really not.. You can have all those rules and still not be in control or you cannot have all those rules and be in control. It really doesn't matter so why not give in a little bit and be a little more relaxed be a little more lax. I guess that's when you become a little more human. As you go and forget about some of those rules.

I: I think your students appreciate it. I'm sure they do.

C: I bring my tea in too!

I: Again sorta watching the kids.. I think they appreciate it and feel good about it. Going to some of your methodology.. You do a lot of explaining using diagrams or some sort of a visual. It could be a box diagram or a linear type of diagram but you explain using diagrams a lot. Do you know why you do that?

C: Well, I think that the more means that you have to help the student to see what it is that you are talking about is really important because a lot of kids just don't pick up on the verbal. You know, they need something else.. They need the visual along with the verbal. I know there are other methods of illustrating a point besides those two but I think in biology those are the primary methods and you have a handle on things on what you do in the lab as well. Like the blood pressure stuff we are doing today. I mean what better way to talk about blood pressure and illustrate the concept than having the kids actually doing it? So I think it is just that I feel that it gives an extra reinforcement - it reinforces what you say - if you have a diagram to look at. Diagrams usually have to be simplified and the saying that a "picture is worth a thousand words" - I really believe that.

I: You're a visual person in other words?

C: Yes. Yes I am. I really..I found that diagrams helped me a lot.

I: See. I'm like you too. I am most helped by diagrams. I have to see it and like for example even names I am not very good unless I see it written and then it sticks forever.

But I have to see it so I'm a visual person.

C: I agree and some kids learn very easily just by being talked to and other kids need that visual help.

I: And when you have a big class you have got the whole gamut too.

C: That's right. And you have got to try to incorporate as many different methods of teaching a concept as you can.

I: And that brings me to my next question which I think you have just answered. And that was that you use a lot of handouts..and why do you like using handouts?

C: Well I don't think that the textbook is perfect in that it doesn't supply a lot of the visual material. I like.. some of the handouts explain things or allow the students to see the concepts much better than the diagrams in the textbook. Some of them seem more accurate and or simpler not quite as complex. And some of the handouts are just not in the textbook. And it is one thing to flip on a transparency but it is not going to be much value to the student when they are studying for their exam to try to remember a transparency that they saw.

I: And if they don't reproduce it accurately

C: That's right. And you spend a lot of time reproducing it when you don't want the kid to spend the time sitting there reproducing it. You want the student to spend the time looking at it and understanding it and listening to an explanation or giving an explanation and not drawing down the boxes or drawing the diagram of the heart although I mean that would help. I think that when it really comes down to learning it sometimes you have to try drawing out the diagram yourself. The heart for example.

I: Maybe that's what the students would do in their studying.

C: That's what I would expect them to do there and not spend that time in class because the time in class is so precious that you any way that you can condense that time down in order to help get through the concepts..or at least to help just introduce the concepts and then let them try to internalize, grasp the fine detail later on.. and have this same stuff that they had in class seems to help and try and remember this stuff. To really truly remember what really happened in class I think that you have to look at it very shortly after the class and most of them won't do that. It will be several days or two weeks that they will review that material.

I: When they are preparing for the exam.

C: When they are preparing for the exam, the night before and I am under no delusions to think that kids go home and study what they have had during the day. That's a technique that some people incorporate and other people never learn to use. It's useful, it's helpful and I think it helps you to learn things much quicker. It's better for long term incorporation in the long term memory but those kids don't.. they don't do that because that's not their ..That's something that is learned with use.

I: You and actually the rest of the teachers in your group, in your school work through your noon hour as if it were another class. Why do you do that?

C: Well I think that most of it is constraints of time in class. With 30 between 30 and 35 students in some of the classes like Biology 30 class not even the IB class which are generally smaller, you don't have virtually any time to give individual attention. I mean if you give a few minutes of individual attention during class that is about as much as you can. So when students need extra help or need to finish something up the only way that they can get that done or get the individual attention is during the noon time because that is a time when everybody is essentially at the school. Even after school people sometimes have appointments or have to catch a bus to go home. They are bussed in so they're gone by 3 o'clock. They don't have the chance to come after school unless they are willing to catch 2 or 3 ETS busses home. So noon is the only time that a student can come in, ask questions, get some help, get some supervision on the microscope or the labs or using labs and.. It's their time really that they have. It's not that I'm not available after school. It's just that they might not necessarily be available after school so I don't even bother going up to the staffroom especially when I know that kids will be coming. I don't even get a chance to go. I get to the office and there they are!

I: They are knocking on the door of the staffroom!

C: That's right.

I: How do you renew yourself for the classes? They just keep on coming. How do you renew yourself so that you can go again?

C: You mean in the afternoon after lunchtime or do you mean the next day?

I: All the time. I mean you have one class and then you have ten minutes and you have to renew yourself for the next class and you face them, you're into noontime and you spend that time with the kids, you have another class. How do you renew yourself between each block? Just work on adrenalin?

C: I think so a lot. I think that you don't even stop to think about it. I think that's it. Once you slow down and you sit down and you go "Ahhhhha" that's when you don't get up any more. But if you can keep yourself going then you don't feel that you have to.. I'm not going to make it. It's not until after school that you sit down and you go "My that was a busy day!" I'd be exhausted. Then you allow yourself to feel exhausted. When I come home I am exhausted and then I think that the renewal comes with a change of activity. You do when-you-are-at-home stuff. So you forget about the school stuff for awhile even just not thinking about it for awhile. If you feel a little bit refreshed I can go up and I can do an hour or two more work after taking a few hours break and just doing something else. I just have to rest.

I: I have found that physical, actual physical things. I used to go into the greenhouse and that used to renew me. Do you have things like that? Or is physical activity a renewal for you?

C: Oh ya. Oh ya. The only thing is that physical activity for me tends to be isn't going

into the greenhouse, it's just doing things for my family.

I: Housework or something like that. Sure even vacuuming!

C: That's right. This is why, now, I have started taking up a yoga - a yoga class on Tuesday nights. I knew that I had to have something to kinda rejuvenate - to rejuvenate me- to get me away from school, away from thinking about school and away from thinking about home and just thinking about just me. Just working on me for a little while. Boy and I've had the class twice and it's really..I've just felt great! I've come home and sat down and done work after that and felt really good. But the next morning cause I'm tired and I'm sore.. My muscles are sore. But right after the class I feel great. So it's like you being rejuvenated like right immediately there..It's just that I should do it every night. Cause you really do feel good just to get away and not think about school and home and concentrate on the exercises and it's easy and it's so nice to do something when your mind isn't somewhere else. That's the key to rejuvenation is to really focus on something else.

I: Get away from it?

C: Just don't think about it until it's time to think about it.

I: The next one, again, it's closely related to your munchies one and your answer for the munchies can be generalized to this one. But I noticed that you do allow some students to just walk out of class for whatever reason. And they never ask your permission and you never said anything to them!

C: Like *Sudent 6*?!

I: So I take it that somewhere there has been an understanding that if they have to go to the bathroom, they don't ask you. And again that just goes with your munchies type of thing.

C: I think that you get some kids that do ask you. And other kids just get up and go. I have never refused anyone to go to the bathroom. Sometimes its annoying cause usually after an exam about five or six people will come up to my desk, they're finished the exam and they want to know whether they can go to the bathroom. And so like five! It's not like I'm going to suspect that they are going to meet together anywhere but it's just that one over here and five minutes later someone over there by then the next one has drifted back in again. After I have been asked about five times I usually stick my head up and say "What is it about this exam that everyone wants to pee that they're finished it!" I just don't see any reason to tell them, well no, you can't go to the bathroom.

I: Well he's just going to do it right in front of you!

C: Well sometimes I'm tempted to say if the kid is always going to the bathroom after an exam - well you get those - they don't seem to go during lunchtime or the ten minute breaks, they wait until the appropriate time in class and it's funny how it always happens not while you're lecturing well not.. sometimes kids will go then too, but it will always be when there is a lull you know like the beginning of a slide-tape presentation

or they are supposed to be working on their notes and you just finished mentioning a few things and now they are going to be working on their notes or at the end of a film. Like they always have to go to the bathroom at the appropriate time and sometimes you wonder gee like couldn't you just hold it for another ten minutes. I mean it will be the ten minute break. Sometimes I'll just say "I'm sure that you can wait the ten minutes." But sometimes I'm tempted to say "No, you can't go to the bathroom to the person who is regularly going to the bathroom."

I: And watch their face?

C: And watch their face and say "If you wet yourself, I'll clean up!"

I: They might take you up on it!

C: That's right! That would be just what I would deserve so I never say that but I do make comments sometimes about kids that go. Just to let them know that I see that this is happening but that I am not making an issue of it.

I: Right.

C: Everytime that they go. Some kids like *Student 6*, this is his third time through biology.

I: Maybe you should suggest that he see the good doctor!

C: I did. I said to him privately as he was leaving. I said, "*Student 6*, how come you are always leaving the classroom?" He told me that he was on a fruit diet! I just said, "Ohh!". At least I just let him know that I was noticing that he was gone and gone a long time too. And I says, "*Student 6*, one of these days, I'm just gonna take a stroll and just make sure that you really are in the bathroom." I don't know how I'll do that - *Student 6*, are you in there? Actually I'd just kinda walk through the cafeteria. So just as long as they know that. I don't think that I need to give them the third degree if they are going to the bathroom but some of them potentially need to be reminded. And that's all that you need to do.

I: What's your responsibility in terms of.. I've already asked you about the running off thing..What about putting away and filing stuff? Again, are the jobs sorta divided up among the coordinators?

C: No. I'd say that anybody can do the filing, put stuff away. Some of us are better at it...than others. Some of us.. it just piles up and if you don't do it it just isn't going to get done and then all that you are left with in June or January is this big stack of fifty assorted handouts sometimes not in the correct order sometimes all mixed up that you have to file and it is just a matter of whether you want to file this in January or do you file this now when it will only take a few minutes cause you have only a few handouts or do you want to file for an hour and try to figure things out. Like I said some people are very orderly. Finished with it, let's get rid of it, clear it out of the way for the next. And others just shove it into the drawers of the desk and it never gets going back again.

I: And then when you go and run off units you don't really know how many you've got..

C: That's right. And they usually end up being chucked in the garbage because who wants to go through all of those units and spend a couple of hours sorting and putting them back in the file cabinets. Sometimes I feel frustrated because I can't do all that filing but since *Teacher 1* is back, she does her share of the filing. On the other hand you think "Well gee, am I missing something? Am I worrying about something that really isn't worth worrying about?" On the other hand I think it is just a matter of organization. Why should you throw good units and handouts in the garbage, especially since they in the office are concerned about the amount of duplicating that we are doing. I can't in good conscience throw things in the garbage - 10 or 20 units and then next semester ask for a hundred or a hundred and forty copies of those units and remember that I have thrown them in the garbage because I was too lazy to file them.

I: I liked your comment about every piece of paper was a part of a tree. That was a good thing for the students to realize.

C: Yah. I try to cut down and use both sides and just be as economical as possible.

I: How do those days that your son doesn't want to go to daycare.. No daycare!.. How do you think those days affect your teaching? ... Can you shut it off?

C: I think that once I drop him off and I leave him that I drive away and I am thinking about him..thinking about him. You know but once you get to school and there are five things on your desk waiting to be done before you get to class. I don't think it is because I purposefully say "well I'm not going to think about this any more." and that I'm not worried about him it is just that now I have a whole new situation on my hand that I've got to deal with this now. He is in good hands. He'll be fine because he's always been fine when I have come back to pick him up. He's been happy! He's been happy. He's been wonderful and that is how I kinda console myself that today is not going to be any different. He's gonna be fine it's just that initial separation and he's going to be OK. And then I think I just basically might slip him into my mind a couple of times but I am able to just put it out of my mind and concentrate on ..

I: That's crisis situation.

C: Ya it is

I: You have to deal with what is at hand.

C: Exactly. I know then that when I go over there.. I think about it again and wonder how is he. How is he going to react? And I am always relieved to see that he is happy doing something.

END OF INTERVIEW II

APPENDIX B-5

THIRD INTERVIEW WITH CATHERINE, OCTOBER 15, 1987

I: Something that sorta been a pet of mine and I really did not become aware of it until just recently and that is, maybe you don't have any thoughts on this, but what I wanted to talk about was the relationship between being a female and authority. The maintenance of authority in the classroom. And I guess part of it and I have been thinking a lot about *Student 2* because she is just so different. She just sorta stands right up. And you know for example, I wonder, would she have behaved differently if you had been *Teacher 6*? I have a feeling she would have.

C: Why? Just because *Teacher 6* is male?

I: Uh hummm.

C: I also look at *Teacher 6*'s personality though.

I: Why he is very different.

C: *Teacher 6* is pretty easy going. And I think she would have behaved differently but I'm not sure how like say..What you have to do is assume that you would have a male with the same personality as I had and then try to compare if she would have..

I: But I don't think that you can ever do that.

C: I know that you can't.

I: Males are just structured differently. They do things differently than females. Another thing that I was just sorta wondering and I have no idea what school she came from or anything like that, but did she have a male teacher last year for example? In her last year of junior high science and did she really like him? And all of a sudden she gets female, she's not really sure about this, sort of giving you the gears and testing you out.

C: That would be interesting to find out. I guess we could just ask her.

I: Another thing. I wonder what her background is? Since she is into golf, that tells me a little bit about her type of background. Because your run-of-the-mill type of kids aren't into golf. It would have to be a parent sponsored type of thing. And I wonder what the view of the parents is of teachers is in general. Is the view.. in my family because I come from a lower class background, teachers were revered. That was pretty special. But then you look at other backgrounds, some of the professionals, teachers are not very high on the scale. They are somewhere down there with your housecleaner.

C: No they are not. I think that's the problem happening in schools like __ where these kids are from upper income homes and that and its the teachers' job to help the kid nō

matter what it takes, no matter how much time, or how much effort it takes that's what you are there for and that is what you are paid for. And even having taught at ___ for one year I can see that.

I: Did you teach there?

C: Ya, just for one year.

I: I didn't realize that.

C: There are some very nice kids and some of them were very demanding.

I: Well there is nice ..There is very nice rich kids too.

C: Sure!

I: But there is always.. Depends on the background. But anyway have you any thoughts on this relationship? Have you had any particular personal struggles just because you are female? That perhaps you might talk about?

C: I think that at least initially the first year that I came to ___ there was a boy in my class and I'd say that was the most significant and the most gut-wrenching problem that I had. He was a poor student and a chronic misser of classes and he came to me and I think because I was a woman he thought that I would be a soft touch. And he wanted to enroll in I think it was a dance competition. Where he and his partner would dance and make funds and so on for.. it was a worthwhile cause. There was nothing wrong with the cause. But it was during classtime and of course teachers have to sign the form saying that yes they permit the student to participate. Well he was failing the course, he'd already missed many many classes so I couldn't in good conscience sign the form. So I told him that I couldn't sign the form and I did try to explain why. He of course got very hostile. And even his girlfriend came to see me about why wouldn't I let him participate in this worthwhile cause and you know that that is probably the furthest thing from his mind is the cause - he just wants to get out of class and have a good time - so I stuck to my guns though, but not after taking quite a bit of abuse from him - verbal abuse - so much so that even swearing, not to my face, but to another student of mine behind my back. Which was overheard by a student teacher that I had at the time. And that was really quite.. crushing. It was crushing. And that was the first time, I think, that my femaleness came out. I felt like how could somebody say..I felt really really hurt. A man, I don't know if a male, would have been quite as insulted by that as I was to be called the kinds of names that I was. And, you know, I felt that I had his best interests at heart. He couldn't see it that way and I think that was the worst, the absolute worst situation that I came across. I never really.. I became very bitter towards him. I thought.. He eventually did leave my class and I thought boy if he tries to get back in there, I just can't. I can't have him back in my class after he's done that. I don't know, a male might have responded differently. But I cried. That really broke me up. But I never..I have never had a situation like that since. I think that I have learned a little bit from it and I'd do the same thing certainly. I think that some ways I've become, I think that it was because I was fairly young too, in starting out, I don't think that that kind of thing would bother me now.

I: It would bother me!

C: Well I suppose it is easy to say and you don't know how you are going to act in the situation if the same thing came up but I think that I would be a lot more, I would be better able to cope with it because it had happened once already.

I: Right.

C: And I think to myself, "Why should I cry about this kid. He's obviously got no concept of what it is that I am trying to do. He just doesn't understand so why should I let that bother me. I'm not going to let that happen again." So perhaps I'll come across another student like that again. I certainly haven't.

I: Really I salute you in respect.

C: One in a thousand. I don't know whether it is because I am better prepared to handle it if it does repeat itself or if I have just never met another kid like that one again. That's the first time I have ever felt very vulnerable as a female and that a male would not have stood for this and again simply because a male teacher is a male the kid might not have been upset.

I: Have you ever run into cultural things.

C: Yes.

I: You know this school is pretty.. It has a lot of different cultures and there are certain cultures that treat females very differently. Have you ever run across a cultural difference?

C: Absolutely. You bet! Not so much outspoken in my class but this one student had this concept about women and the kind of a woman that he was going to marry and how this woman was going to stay home and look after the kids and things like that. So it never really came to a confrontation with him and as a matter of fact he was respectful to teachers - there was no problem there- it was not an out and out disrespect for the male or female but he certainly had some very rigid cultural views and you could see that he probably did not agree entirely with somebody like me having a little baby and coming to school and working and teaching and so on but we managed to keep that out of our relationship. Every once in a while he'd say things like his wife was going to be staying home and so on and the kind of woman that he would marry and I'd say to him, "Well it's nice if your wife agrees and if that's the kind of a woman that she wants to be then that's the kind of a woman you should marry." But if you are going to find a Canadianized woman, your chances are probably not that good of her wanting to stay home and watch your baby.

I: You're in for a rough ride!

C: You know because lots of women are looking to a career outside the home. That's a .. "Oh I'm going back to the old country to get a wife!" I said, "Well that should solve your

problem!" There was never a conflict there.

I: More of a discussion thing?

C: It was more of a discussion and I presented my view and he presented his view and we talked about it and..but it was a friendly..He was not the kind of student that was really adamant that it had to be his way and no other way so it was always a friendly exchange but there was one student one time that actually accused me of being prejudiced and went to the grade coordinator.

I: Ooohh.

C: Which was a real shock to me because the grade coordinator came to me and said so and so and actually another student brought it up first because he had complained to this other student.

I: So this student took it upon..

C: So this student took it upon himself to approach me and said that this student feels that, you know, that he is being treated unfairly by you and feels that you're against him and the thing was that the thing didn't have anything to do with who he was it just had to do with what he did. He, I found his textbook, I think that this was one of the incidences anyway that precipitated..Anyway I found his textbook, it was left on his desk, and I opened it up to see whose it was cause the names were inside it and I saw there was a letter there with his name on it so I knew this textbook must belong to him. So I had him paged down and I said that I found your textbook and I noticed that here is your letter that this letter was inside it. He looked at me and said, "Did you read it?" I looked at him and I said, "I don't read other people's mail. This letter has got your name on it. Why would I open it?" I felt insulted that he would think that I would open up this letter and read somebody else's letter. That took me totally off guard and I think that I didn't.. I let him know that I was angry that he would even suggest such a thing. And then at the end of the conversation he said to me "Oh it was in Spanish, anyway!" What is the point of asking me if I read his letter if it was in another language? So anyway it was an incident like that like this kid was very outspoken and in cases like that accusingly outspoken and I retaliated against that and he interpreted this as I was retaliating against him, who he was. So we sat down and had a conversation about it but still it .. When that's not the way that you feel that you are accused of feeling that way..that is something that is kind of painful.

I: You know there's, in fact in some coffee rooms, I've seen these little signs that say something to the effect that "Your mother isn't here so pick up after yourself!" So clean up after yourself. You know, giving the stereotype to females that they clean up and pick up after yourself or after other people, after males. Do you find yourself doing extra work in that regard because of attitudes of males generally?

C: I'd say in our office. That's probably prevalent. *Teacher 1* is much worse that I am. She finds it..she is very neat and organized person and that may have something to do with her being a female plus I think her personality is just that way. But I do find that sharing an office with males like *Teacher 6* and *Teacher 7* and that that things just

wouldn't get done just regular straight organizational types of things. Perhaps that just because their personalities are that way and maybe because they are males and like people have been picking up after them. And I do find that because I share that space and I like to be organized that I can't wait for those guys to get organized and I just pick it up. I just do it if I have the time.

I: Get angry?

C: Well I do get angry but now that *Teacher 1* is back she takes over that function really because she lets people know in no uncertain terms that this is your mess and clean it up. Get it off of here.

I: Like the dishes! I noticed the dishes.

C: Exactly! Whereas I'm willing to let it go for a time but then if I happen to be heading down to the cafeteria and these dishes are still there I'll pick them up and take them down.

I: And you're walking away with the mold and stuff..

C: That's right. You know it just looks..Who wants to use the sink and that when there's a bunch of dirty dishes in it. So Yah I think that's probably very true that I tend to pick up after... Not so much the kids.

I: Well even the kids..

C: I try not to pick up after the kids. Male or female. I'm not their mother and they want to live in a messy space so long as my space is neat and clean. But I do ask them and address them equally and I don't go trying to prod one or another to clean their particular..and they're usually quite good. I think it's more the people that you share an office with..I mean you really share very little space with for a very short space, I mean, it's not a permanent thing. They don't have their belongings there all the time. They bring their stuff and then they leave again. They don't have anything there permanently so I find less of a need to.. When I do pick up like when I pick up things in the hallway and that I don't do it because I'm female but because I'm trying to set an example. To any of the kids that you know there is garbage on the floor. Anybody can pick it up and put it in the garbage.

I: I noticed that there is quite a bit.

C: So I do not because I feel that I should pick it up - it's my job but because geez maybe there are a few kids around that will see me picking this stuff up and putting it in the garbage..

I: It might spread.

C: That says a lot more than.. you can never find out who dropped it anyway. It could be there for a long time just because someone is sitting there doesn't mean that it's their garbage.

I: Have you ever had instances where you have worked really hard for something in the biology department and essentially all of the work has been yours however subsumed under the biology department has done this, this and this whereas all the work has essentially been yours? Have there been instances of that kind of thing happening?

C: None that really spring to mind. If something like that happened then it was so minor that obviously if I can't remember it wasn't very significant.

I: One of the other times when we talked, you talked about one of your priorities being getting along with people. Do you find that that particular priority sometimes makes you do more than you probably should.

C: A little bit.

I: How do you maintain your authority? Say within your department? and in class?

C: Well I suppose that and I'm getting better at this and that is speaking up. As something happens that you're not happy with and you feel that you have been infringed upon.. I think that the speaking up comes easier when you know somebody fairly well. For example, *Teacher 6* and *Teacher 1* and that.. I am quite comfortable with them now and I am not afraid if that's the right word to use. Of what they will think of me if I tell them I don't think that this was handled quite correctly. Or I don't think that this is fair or that this is right. I think that as you work more together you feel freer to do that. I think that initially it's very..it's difficult to do that. At least I find it that way. Someone like *Teacher 1* might not find it that way. At least I don't think that she does because she comes in quite easily and makes sure that things are being done appropriately. She has no problem maintaining even grasping authority right initially. Whereas I'm not.. I don't come on quite that strong at the beginning but as I get to know people and so on then I'm less reluctant to express my point of view. As I get older too you think about when you were younger and you're and - you always felt that everybody knew more than you anyway - so you'd listen and you'd learn and so on. After a while you realize that geez just cause they're older doesn't mean that they do things better. And so with age too. Of course I haven't been to another department for awhile. I have been at ___ for seven years so I'm fairly comfortable with the people that are here and I find it fairly easy to talk to them and tell them that I don't think that it should be done that way.

I: How about within the classroom? With your students, how do you maintain your authority?

C: Well I think that by starting right at the very beginning. I don't believe in being lax at the beginning and then trying to assert some authority in the end. I'm a firm believer in asserting authority right at the beginning and that is when you really have the students too. Because they are in a brand new situation. Some of them may not know anybody else in that classroom, very infrequently do you get a class where everybody knows everybody. Most kids only know one or two people in there and also for many of them this is a fresh start. And they are really interested in the beginning in doing well. So that is when I believe that you should assert your authority. And I think I do that first of all by volume of my voice. Sometimes *Teacher 6* says "Geez, you're shouting at your

kids again!" He can hear me through the walls. But there is something about voice. If you speak very quietly you are going to lose them right away. First of all because they can't hear you and like the acoustics in the classrooms are very very bad so I just talk loudly because I want everybody to be able to hear me. There is nothing worse than listening to somebody that you can't understand because you can't hear them. So I think that voice is one thing and that projects to them that I'm not afraid to speak up and even you guys at the back are going to have to listen because you can't help but listen. So projection of the voice and I think the way that you carry yourself too.

And that you are not afraid to move into the class like that you are not glued to the blackboard in the front but that you actually will move towards the middle or towards the back of the classroom while you're talking. I try to do that every once in a while although sometimes you get lulled back to the front because you feel that your back is toward the people at the front so that you are kinda in a bad situation when you are in the middle of the room but.. And just letting them know right at the beginning of the first class where I stand as far as attendance and so on goes and giving little reminders every now and then. The key is ~~Not~~ to slack off.

I: To be consistent?

C: To be consistent. If you are asking kids to be on time and they should be on time all of the time and not just be on time at the beginning of the semester.

I: And you yourself should be on time?

C: That's right.

I: I noticed that you are on time.

C: Well I try but again there are times when ten minutes when talking to a student is not enough and you are wanted on the phone and then an administrator wants to talk to you and somebody else asks a question and you are not on time. And so I am not really rigid in enforcing that but I do let people know that if you have a chronic problem you are a chronic late that is what I am concerned about. So in trying to enforce rules and trying to set some example yourself. You're ready to go.

I: Once you establish this authority, how do you enhance it?

C: I guess by carrying through. Once you have threatened to do a thing if they don't..For example if kids are late chronically I actually remove them from the class. Having them go down to the office and report to the administrator because they are late. Other kids see that or hear about it and recognize that you do run the classroom.

I: Something that I have noticed is that people go to you as an authority - other teachers. For example *Teacher 8*. He didn't go to anybody else he went to you. He had to bypass several other people who could have just as easily have helped him. I noticed even *Teacher 7* he tends to bypass others. Catherine will take care of this type of thing. How do you view that? From my perspective they seem to view you as an authority in biology.

C: I think it is because I have offered help. *Teacher 7* was new here last year and I did try to give him as much help as I could. I spoke to *Teacher 8* too, when he first came and he was interested.. and he had to teach the Science 11 and he wanted some help in getting started. So I think it is because I have volunteered some help initially and that is why they come back because they know that I have offered and I am willing to help them and that they are not infringing on my time that they come ask questions or how to book out this film or that film or what is coming in or what is available and so on. I think it's because they know that I have the information and am willing to give it to them. Like *Teacher 1* she had been gone for two years so *Teacher 7* has not had to do with her before really neither has *Teacher 8* and *Teacher 6* is pretty busy being department head and all and so.. I've been there as long as *Teacher 1* except for the two year's sabbatical that she took but of course they won't know that.

I: Especially if they are new to the department. How do you get your strokes in teaching?

C: My strokes? That means my pleasures!?!

I: What is it that keeps you going? Obviously it's gotta be something that sorta massages the ego and says, "Hey you're great!"

C: Yah. I think if the kids are happy. You know if the kids come up and they talk and they're happy and they're interested and we have a good laugh about something. I think that is the best thing in a classroom. I feel really drained if I've had to talk the whole class and we've had to go like mad just to cover a certain amount of material and there's been rush, rush, rush and there's been very little time to throw in a joke or somebody mention something or then I feel that yeah we did a lot but I sure feel lousy. It's the feedback from the students that's what I feel that..

I: Do you get a fair amount of it?

C: It depends upon the class. Some classes are pretty hard. They are not there to give anything back. They just want to absorb and let's get it over with. So it depends upon the class. It depends upon the climate that we've established. It depends upon the personalities.

I: And probably a lot goes on in the students that you don't know. And they come back seven years later and say "Boy, did I like your class!" They wouldn't volunteer a word. You didn't even know if you were getting through to them.

C: And it is very rare to have students to come back and say that and that is why it means so much because so few kids actually do it. So even though they may feel it they don't say it. One student comes back and says thank you and that is probably the biggest. It is worth more than money. It is just "Wow - thank you so much for coming and saying that. You have just made my day!"

I: I know one of my neatest experiences was when a group of kids used to call me "Mom". They would come and put their arm around me and ask, "How are you today, Mom?" I took it to mean one thing, and whether they meant I was sorta like their mom or I'm not

sure. But it was neat.

C: You know how it was meant. It was a warm term.

I: You know, going on to something else. Teachers are being described as gatekeepers, because you have the power - the authority - to fail, to pass a student. That kind of thing. How do you feel about this function? Are you comfortable with it?

C: I don't feel that I have as much authority as I think I do. When it comes down to the marks you have got a kid with a 47 or a 48 percent like they have been borderline the whole .. I just don't feel that I have that much control over their marks, I just feel..

I: Well, what do you do with a 48?

C: I round it up to a 50.

I: Give them a chance?

C: That's what I am instructed to do.

I: Oh yeah.

C: There is a policy within the school where if a student has a 48 or a 49 and is a credit-no credit/pass-fail situation or a another one is the honors category - 78 or 79. That one I have a little bit of trouble with because I wonder if an honors student really has 78s or 79s whether he really is an honors student or just a very good B student. So ..But with the 48s and 49s I just feel that the pass/fail thing is just too significant. I don't care about the honors thing because that is just a prestige... but the kid passed the course he did fairly well in the course maybe this kid really is not an honors student although I usually do tend to round 78s and 79s up because it is also school policy but I don't.. I would just as soon leave it at 78 or 79. Whereas something significant like pass/fail, 48/49 I don't feel like I have to hold anything over that student's head. I agree with that policy there. That student should be given the two percent benefit of the doubt because the consequences are much more significant of that than reaching or attaining honors. So I don't think that I have a big power. A lot of it is being told what to do there and anything below that there isn't much that you can do about that. It is really out of your hands and I don't think that you have as much power as people think that you do. Cause the marks don't lie and there..if you are down there..on paper it is not you making the student patterns or deciding whether they pass or fail. There are the marks right there in black and white.

I: And usually you have rounded up every mark anyway.

C: That's right. Well our computer sure does. We put them in and it converts it to a percentage and it always goes up to the next higher percent and so that's why too when kids come to you and want to argue about half a mark or a mark I say "Save your breath. You are talking about half a mark out of a thousand marks that you will get in this course." It is really insignificant to start adding the pluses and minuses because your mark probably won't vary maybe one percent. Maybe one percent tops. Maybe one

percent difference. So..

I: How do you view diploma exams? and of course in your case IB exams?

C: Well it is always difficult initially. As you change because you know that the pendulum keeps swinging back and forth, right? You have done one thing and somebody has decided to change that's no good so you go on to something else. I haven't been around a long time but I have seen the pendulum swing across a couple of times already in my high school career and in my teaching career. I think gradually that you come to accept. Now I see nothing wrong with diploma exams. I find that I can use it to try to motivate the students to keep up with their work and to review exams because there will be a government diploma exam. It almost seems to add little more credibility to it than in-school exams although in-school exams can be just as significant I'm sure as a diploma exam. I have no problems with them. I find that it is nice to be able to see just how your students are doing compared with a provincial average. I don't believe in going from school to school and comparing the biology average with this school and the biology average with that school. You don't get the same students, you don't get the same, especially rural schools, the same type of equipment you don't have the same amount of money as we do. Besides somebody has to be below average to make the average. So.. I don't care about beating out *School 2* or anything like that. I just want to see that we offer that we prepare the students well for exams. And even if we slip up one year somebody has got to be below average and we just have a different crop of kids and maybe the situation that year with teachers just wasn't very good. Maybe somebody left for maternity leave or died. Things like that happen and are bound to affect what happened in the classroom. There are just too many variables to let it bother you.

I: Is a high average on a diploma important to you then?

C: No. I mean, it is nice to see because you like to think that you know, maybe you've been successful too as well as the kids being successful. It is nice to see but I don't revolve my classroom activities around it. I don't say.. I don't only prepare my students only for the diploma exam. It is not my main my central aim.

I: What accomplishments are you most proud of in your teaching life?

C: Some of the individual projects and that that I am doing. Like the water quality project which is accumulated over years of work. And when you put that much time into something you have got a finished project that other people are using. There are so many little accomplishments. There is very few huge things because you are basically doing the same thing year after year completing a course and getting so many kids through a course and that is an accomplishment although you have done it so many times that it doesn't seem like..The first time it's pretty significant but after you do it over and over again it just becomes one of the accomplishments that you do nothing outstanding just part of your job. I suppose when you look back maybe and you think about the numbers of kids that have passed through your course like that and when that hits thousands of kids I mean that has got to be a major accomplishment. But while you are doing it you are just slugging away at it little by little. Eventually the number of years of teaching will be an accomplishment.

I: Our time is beginning to slip away and you have not eaten your lunch. I am going to ask one more question. I was really excited about your Valley Zoo trip.

C: Well good.

I: And you really had to scramble to get all that stuff prepared. I mean you had to go over to the zoo and preview the stuff and you had to make up letters, you had to do just all kinds of things that were extra that were over and above what you were doing regularly.

C: And the money!

I: Yeah the money issue. Why was it important for you to go? Why did you do all that extra stuff? Why was it important to go?

C: Well first of all I don't think that we would have gone. It was nice of somebody to put the suggestion out. That was Teacher ~~9~~ at _____. He obviously had a reason. He wants us to run through and pilot it. So it's nice to be asked and really the opportunity was sorta thrown in our laps that way. Like I said the kids in the IB and in any biology course get so few opportunities to go on a field trip and that's really what biology is really all about. It is not sitting in a classroom and taking notes and seeing films and so on I mean biology is a science and it is actively done. It is a lot like chemistry and physics but even more than chemistry and physics because a lot of that stuff is done in a lab but biology is more like getting out there and getting into the community or the ecosystem that you are interested in looking at and any time that you can have a field trip, the money is there, the time is there or it is a possibility then you have to try. I think that we get too complacent. It is so much easier to not collect the money, to not look at the materials, to not fill out the forms. I mean it is just so easy. The kids don't.. I am not sure that they get as good an impression of biology if they don't take some field trips.

I: So I take it that fields trips are an important part of your teaching philosophy or the teaching of biology.

C: I would like to take more but were it not for finances and the fact that you take kids away from other classes for an entire day to go out on a field trip and then you incur the wrath of other people if you do this four or five times with the same class. That's really the only thing that hold back more field trips maybe a couple per semester for each class. Once you get a field trip, it is a lot of work, the worst is, of course, the meeting that you have done before when you are trying to get a feel for yourself.

I: But you learn together.

C: Yeah. You do. And you feel more confident the more that you go out the more confident you are.

I: I am going to stop at this point and let you eat your lunch.

C: Oh no problem.

END OF INTERVIEW III

APPENDIX C

APPENDIX C-1

INTERVIEW GUIDELINE QUESTIONS - TOM

INTERVIEW I

1. Why did you become a teacher?
2. What is your philosophy of education?
3. What do you value most in teaching?
4. What do you think the "heart" of biology is?
5. What is the nature of effective biology teaching?
6. What kind of a person do you see yourself as?
7. What kind of a student were you?
8. What are your priorities in life?
9. How do you balance your commitments?
10. Think of one or two of your teachers. What characteristics did they have that you admired?
11. What are some desirable characteristics of a "good student"? a "bad student"?
12. In what kind of learning environment do you think the best teaching/learning occurs?
13. Is there something wrong with education today?
14. Why are some kids illiterate?
15. What do you use as a basis for determining course content besides the curriculum guide?

INTERVIEW II

1. Why do you have your students do labs?
2. Approximately how many labs do the students do in Biology 20? in Biology 30?
3. Do other teachers do the same labs? Do the other teachers work independently?
4. Do you think your administration is supportive of what you do?
5. Why do you dress in a shirt, tie, and sports coat or a dressy sweater?
6. You give assignments for homework. Why do you think that is important?
7. Do you check to see whether homework is done? How?
8. You use very few handouts. Why do you feel handouts are not necessary?
9. How do you feel about students, teachers, visitors being late?
10. I think I sensed a slight feeling of guilt about your two-day absence. Yet, you work very hard at getting release time for teachers in your role as coordinator. Is there a dichotomy in your beliefs? Explain.
11. What do you feel you are accomplishing by having students work out answers to problems or questions? How do you know this?
12. You described yourself as a "low-key" type of guy. What do you mean?
13. How do you go about making students feel good about themselves?
14. What guidelines do you follow concerning students taking a bathroom break or leaving the room during a particular class?
15. How do you feel about interruptions to your class e.g., knocks on the door, PA?

16. I noticed that many days you forget to do the attendance sheet and seem eager to get to the teaching. How do you feel about the paperwork aspect of teaching?
17. Does the school have an attendance policy?
18. You often use the phrase "Does that make sense?" after an explanation or after going over a problem or question. How do you get the answer to your question?
19. I noticed that you said, "We'll work it through together later." to a student. When is that "later"? Do students come for help at other times?
20. Why do you think it is important to have students do problems on the board?
21. When you ask a student a question you are quite persistent that he or she at least attempt an answer. Why?
22. How do students adjust to your problem/question-solving approach to teaching?
23. What do you think you are accomplishing by this approach? How do you know?
24. You share something of yourself with the students - "I used to swim" or "I wanted to be a ..." or "I did some reading this weekend on DNA and aging." Why?
25. When you address a question, you often do it to a specific person, "... I want you to ...". Why do you address the specific person rather than the whole class to begin with? Do you think that it turns others off if you address a specific person initially?
26. When you discussed with the Biology 20 students the idea of eating cells - chicken, ham, lettuce, yogurt - you said, "Isn't this wonderful? I think so!" Was there a purpose to the comment? What were you trying to show the students if anything?
27. You had made the conclusion that you felt that separate school students had a better attitude and were more willing to work than public school students. What observations have lead you to this conclusion?
28. You indicated that you carry a heavy marking load. What do you mark in a lab? Do you write comments or just use check marks? Do you discuss any labs individually with students?
29. What does your marking load consist of in addition to the labs?
30. What guidelines do you follow in the return of material you take in for marking?
31. How much time do you spend preparing for class? How much time do you spend marking?
32. Do you collect multiple choice questions back? Why?
33. You indicated that you dropped the student's lowest mark when you computed their marks. Is that for every reporting period? Why do you do that?
34. Why do you feel it is important to take time to discuss report marks with each of the students?
35. Do each of the biology teachers work independently? What sorts of things do you do that are the same? When do you get together to discuss curriculum and share ideas?
36. How did -- and your IOP student do on the genetics examination? How are you dealing with their lack of success? Does the school have a policy concerning dropping out of a course?

INTERVIEW III

1. You now have three different groups of students in Biology 20 - cloners, debaters, and those who have not chosen a project. You seem comfortable with

- students moving in multiple directions. What does the phrase "control of students" mean to you? How do you maintain "control"?
2. In observing you I get the strong sense that you are the "authority" in the classroom. How do you maintain authority? How do you enhance it? How is the idea of authority and control different?
 3. What guides do you use to help you choose material that goes beyond the curriculum i.e., smoking, cloning, genetic engineering?
 4. You told the Biology 30 students that they would have a "seminar day". What do you mean by that? What happens during a seminar day?
 5. I sense that you are "struggling" with the Body Fluids Policy. I think that you are feeling a significant impact on your Biology 30 course. What are the main impacts that you are feeling?
 6. How do you think the Body Fluids Policy will affect ordinary Joe Blow teacher?
 7. How or where do you get your "strokes" from teaching?
 8. Teachers go to you as an "authority". How do you view that? Does it make you feel good?
 9. Teachers are sometimes viewed as "gate-keepers". They determine who goes on to the next course and who doesn't. How do you feel about this function? Are you comfortable with it?
 10. How do you view diploma examinations? Do you think that they are necessary? How do you view some of the uses that are made of them?
 11. You spoke of this school being very successful in terms of diploma exams. Why do you think this school is so successful in getting high averages? Is getting a high average on a diploma exam important to you? Why?
 12. What is/are the "essential ingredient(s)" that make this school what it is? What about its newness?
 13. You are obviously doing a lot of extra work and coordination (resources, Prairie Biological field trip to work out some mechanics on cloning, thinking how to implement the cloning experiments). What rationalizations do you use to convince yourself that it is worth the time investment? Why is it worth your while to do all this?
 14. Do field trips fit into your teaching framework? If so, how?
 15. You sometimes use student answers or something they do as a focus in your teaching. Why?
 16. What do you think identifies you as a biology teacher in the school?
 17. What are some indicators of successful teaching?
 18. In your role as "teacher" which accomplishments are you most proud of?
 19. What do you draw on to deal with any problems that develop?
 20. If you were the director of curriculum what changes would you make to the science curriculum? Are the contemplated changes good ones?
 21. If you were the director of evaluation, what changes would you make?
 22. Are you in favor of a general science stream? Why?
 23. There seems to be some opposition to a general science program. Why do you think there is this opposition? How would you go about alleviating this opposition if you were in a position of authority?
 24. How would you go about trying to implement the program i.e., what is the best way of going about implementing a general science program?
 25. Being here with you have been a wonderful enriching experience for me. Has my being here affected you in any way?

APPENDIX C-2

FIRST INTERVIEW WITH TOM, OCTOBER 21, 1987

I: What I wanted to do today was to just ask you some general questions.

T: OK

I: So I have my little sheet of questions here so that I more or less ask the same ones or at least get some of them. I know that your background is biochemistry so therefore you were in science. Somewhere along the line you have switched to becoming a teacher - to education. Why did you become a teacher?

T: Well I guess I was teaching at the university in the lab situations. I enjoyed the teaching aspect more than I enjoyed the research aspect. I was also, I thought, better at the teaching than I was at the research. I was not a very careful scientist. I look more like a galloping gourmet than an analytical chemist certainly and I guess because of that I found that I enjoyed it and I looked forward to the teaching aspect and one of the things that bothered me about the labs - I guess didn't bother me because I enjoyed doing them - the labs at the university were so structured that I saw better ways of doing things I guess. I thought it would be interesting to have my own classroom and you know be creative and try some different things. I saw the university doing the same things year after year after year and some of those labs were six hours of material that you try to cram into students in three hours and I guess wanting the freedom to be able to try different things and I wasn't given that freedom at the university so I thought it would be neat to teach high school or junior high. To have your own science class and that I guess was what got me into it.

I: Any regrets?

T: No.

I: Any thoughts to changing careers?

T: You know that I have had some opportunities to do that and I haven't. No. I enjoy some of the other work that I am doing that is associated with the school and really my job has more diversity than almost any other job that I look around and see. I teach, which is something that I really enjoy doing, even when I am not feeling well like this week. I still enjoy being here. You know, I am a very lucky person. I'm in a job that I enjoy, I'm not teaching 100% of the time either and I have breaks and some of the breaks are good. I think it is really positive if I do a number of other things from semi-administrative which is good for me. It is tough to be a teacher 7 of 8 blocks or 99% of the time and I have some other things that generally keep my interests up.

I: You know you have a.. and I'm not sure if I want to call it an advantage because it puts my evaluation on it but you have a unique situation where you deal with a lot of different

teachers so you have a lot more interaction with others than say a teacher who is teaching 8 periods of the day type of thing.

T: Umhuh. In fact most of what I do sort of in the administrative capacity is listen, encourage and when I do budgets and things like that people think I am making a lot of decisions and that really is a misnomer. If you knew how few decisions I actually do make but it is a matter of listening to people and getting them to talk to each other. It is a matter of bringing them together providing an environment that encourages curriculum development. Encourages them to try different things sometimes knowing that they don't always work. Being supportive on that end I guess is where I have been successful if I have been successful, that is and you know, it is a really unique job. I get to work with teachers from the positive aspects of education which I think is curriculum development, setting goals, evaluating the goals, and not dealing with student attendance problems which tends to be the down side and the tedious side and the boring side.

(Interruption by a knock on the door. Part of conversation missing. The laboratory aide and secretary for the science department was at the door and we talked a little about her.)

I: She made me feel so at home. I mean it was just wonderful.

T: She is that. This is her second year here and this is kind of a unique science area anyway. I am second oldest one in the science area which is.. you know at ___(previous school Tom was at) I'm still the kid.

I: Yeah that's right.

T: And we all go to the conference together.

I: Yeah I know she was telling me that she had gone.

T: Well how many lab aides go to the science conference?

I: Oh yeah!

T: That is so neat. And we went over to the Alberta Research Centre together as a group. It's really funny to see the transformation in some of the people because some of them had taught at a school where they were the only biology teacher.

I: So you do have a fair amount of collegiality in your department. So far I haven't seen it because everyone is busy and that kind of thing.

T: There is an awful lot.

I: Well that's good.

T: There are a lot of people that socialize on the staff. In fact..

I: Oh, you socialize outside of school.

T: Outside of school and a lot of collegiality on the staff. It is a unique staff, Cheryle. It really is.

I: That's great. It is a great place to work. I know that (Name of principal) obviously sort of fosters that kind of.. I know just in my first introduction to her that was already clear that she likes that. And likes the staff and encourages that kind of thing. On to heavier kind of things..

T: Ok..

I: What is your philosophy of education?

T: Does anyone really have a philosophy of education?

I: Probably not!

T: Yah. I guess I do. Student self-esteem is probably what I work on the majority of the time. I have been a successful coach not because I have had the best swimmers or the best athletes because usually they weren't the best athletes. They are usually the little guys that no one else wants to deal with and they are too old for volleyball and basketball and I guess it is just being positive trying to be positive in the classroom to let them know when they get a wrong answer but to recognize that it is just a wrong answer. There is no big problem in getting the wrong answer. There's.. You take a chance and it's people, I guess, that don't take chances that never really learn. It's kinda interesting because when our school board brought in this policy on excellence a lot of teachers, school board officials especially, interpreted excellence as meaning the best of things and that is not really my philosophy. My philosophy is maybe being the best that you can but it's that expectation that we should be the best that prevents a lot of people from trying things. It holds a lot of people back in developing skills that they may actually develop and you may start at something and not be very good at it at all and it is only after a year or two that you really become very proficient. So I guess if I have a philosophy too, it is to prevent that type of stratification where students look at one particular student and say well now there is someone that is really good in his class. He is a real good biologist. That really may not even be true. Most of biology is not writing exams and getting high marks and for them to appreciate that there are a lot of aspects to it. I guess, too, sort of foster an environment that helps their self-image is probably the most important thing.

I: And see you have somewhat answered my next question because my next question was what you value most in teaching.

T: I would say that. Their own respect. Their respect for each other their respect for me and of course I have to respect them. It is a two way street so I think that's most important.

I: What do you think the "heart" of biology is? What are the most important things that you would like to get across in teaching biology?

T: Well I think from my perspective it is beyond the content of biology and that is that

biology touches their lives. It is number one immediately personally relevant. That there is a purpose in learning and understanding biology. They come away with that I certainly have accomplished something but I think a future goal or a further goal rather would be that they have a responsibility to others and that there is a certain amount of biological scientific literacy that they should possess in order to appreciate the impact that they have upon others, that the impact that they have upon the environment. I would think that those are sort of key things that are very broad and very open I know but..

I: That's OK because this is that kind of a question. When you say that you want them to know that there is purpose to biology; what do you mean by that? Can you expand on that?

T: Well I think on the very personal level when we do physiology for example, it's an understanding of their body and how they function and to understand growth developments, to understand differences too between different people and different organisms, to appreciate interaction - man and environments, man and man; all of that certainly is biology.

I: How about woman?!!

T: Well as a species!

I: OK What is the nature of effective biology teaching in your view with that value and that philosophy then?

T: Well.. obviously student involvement. The other thing is that I want to provide them the opportunity and I don't know if you have seen much of that yet, the opportunity to interact with each other. What we usually do is have some seminar days after labs are finished and throw things out and get into small groups and I guess my feeling is that they can learn as much from each other about content in biology and I'm not talking about higher social values and things like that. I'm talking about actual biology content that they're going to learn from me. What I have to do is sorta lay out some challenges for them. And to make it reasonably interesting I guess is the other thing. Is that it has to be interesting. There is some content obviously that we do and it is didactic at times. There is no such thing as totally interactive biology because there is some terminology and some phraseology and some basic core material that they have to develop and understand before they expand upon it. But I guess providing the opportunity that they can do some critical thinking; providing the opportunity that they can do some application and that's teaching to me.

I: What kind of a person do you see yourself as?

T: Tired!! (Laugh) One that seems to..ahh I'm active. I don't think that I am afraid to trying things. I have tried a number of things all of which don't succeed. A person that quite often takes on a little too much and runs himself down, a person that has to become a little bit better at delegating work, and asking for help, I would think.

I: And maybe saying "No"; better at saying "No"?

T: And maybe saying No, yeah I gotta do some of that in fact I have been lately. I have been saying "No" to the Evaluation Branch. I have turned down a few things there so I'm getting better at it. I dunno..I'm happy and I think that is important. I enjoy what I am doing so I think I am very lucky too. So if I was to describe myself it would be happy or lucky and some very positive things generally when I think about it.

I: What kind of a student were you?

T: Not a great student in high school.

I: Now what do you mean by that?

T: Academically I was not a 90% student. I was lazy in junior high. I was incredibly lazy. I was a very poor student in Grade 6 as a matter of fact. I almost failed Grade 6. I went into Grade 7 and sorta of a whole new world opened up to me and I did very well in Grade 7 because of a science teacher. Grade 8 and 9 I got a little lazy. It was a different school I was at. It was a shame. Not the same quality of science teacher. It affected me. I got a little lazy and then I always sorta knew that I was going to university and sorta picked up my academics between 10 and got a little bit better in 11, better yet in 12 and kept going into university. I was a good student at university. I had high marks at university but as a high school student I can..I know what their feelings some days were.."Oh no! Another day of notes and.." You don't take it personally. I guess if you've been there you found everything super fascinating, exciting, and you were always a top notch student you may not always understand others: I think I do.

I: What are your priorities in life?

T: Oh good god, Cheryle! Ahh..I..

I: Am I jogging you to think about them, maybe?

T: Actually you are. You know, I guess family is probably the number one priority. So obviously not..

I: When you say family, what do you mean by that in terms of providing them with material things, or taking care of them that way..what do you mean?

T: No. Naahh. Being with them. In fact rather obviously there are some places that I could have made more money than what I am doing and you know money has not been the major..laughter..to me.

I: I know that!

T: So I guess self-esteem personal self-esteem. I would like to be considered by colleagues and mostly by students -that's much more important- a good teacher. Ahh..I want to be a father that's there for my kids and I guess that's the number one priority. I want to make myself available to them. I want to be open to them. I want them to know that they can count on me come time to make..; whether or not they have designer jeans doesn't really bother me one way or another..Laughs..

I: How do you balance your commitments? You know, your family commitments then, your children, your work, your commitments to yourself. How do you balance that?

T: Actually I don't find it all that tough. I really don't. I spend a lot of time with my kids. Ahh..I don't watch a lot of television, I guess, I mean a lot of people just waste a lot of time and I do some. I watch baseball games and hockey games which are kinda of a waste of time. But I guess you find time, you set aside time, your day may be a little more hectic some days but people who are busy generally find the time.

I: Right. I guess part of it is organization too.

T: Yeah. I think so. My desk wouldn't demonstrate it though a whole lot of organization. But I have got a good memory and I don't write a lot of things down but I keep a lot of things in my head. I'll wake up in the morning sometimes a number of different things that I have to do as well as my teaching and I find that I am able to remember them and keep them all in order. I don't make lists for myself. Ahh, my file cabinets, despite the fact that its five areas within the school that I am coordinating and there is a fair amount of coordination that goes on in curriculum development, I find that I am able to remember it, even as far as textbooks. Like I can tell you which textbooks are used in English 10, 20, 30, 13, 23, 33. I go to English meetings and I am astounded because the English department head doesn't know and because he or she only teaches English 30. I figure either that their memory is poor or it is not a very high priority. I do know that I have a good memory.

I: I would like you to think of one or two of your teachers and what you admired about them. What characteristics did they have that sorta of inspired you perhaps or just plain admired? And perhaps tried to emulate?

T: You know, it's..I mentioned a teacher in Grade 7 who's very enthusiastic, yet spoke broken English, wasn't the .. certainly wasn't the type of individual that you would think would .. and most people didn't really like him. But from a personal note he developed some self-images, self-esteem, encouraged me. Something that I try to do to others. And he didn't know that when I went in I was a good student. Consistent high marks were possible. He believed it. I guess that was important. I think of other teachers who had a sense of humour which is certainly important. There are some days that we all feel down and if somebody is there that can look at the lighter side of things and sorta recognize that education is important but it's not so important that it's rare that you can never sit back and laugh and you can have a good time and enjoy the process. I guess it's probably those two things are things that stand out in teachers that I have admired.

I: What are some desirable characteristics of a good student?

T: Interest. Curiosity. I guess that's about it. Some respect. That's kinda essential. (laughter)

I: What sort of things symbolize, in your eyes, a bad student?

Interruption here from someone coming in and requesting something.

T: I guess someone that doesn't want to try. Usually they are afraid to try. Usually they are afraid of failure. Boredom. They are not interested. They come into class and they are lethargic. They are almost defying you to teach them and that to me is not a good student. I mean, we have all met them. There are kids that seem to be bored with everything. No matter what you do they are bored with it. They wanna do something else really.

I: What kind of a learning environment do you think fosters the best teaching/learning?

T: Well...I mean for wanting(?) which students are not afraid to make mistakes. They are given an opportunity to try some things. I still believe that it has to be structured; it's not an open environment by any means. But there has to be some structure and some direction but they're not locked into an lock-key step so as they move from Point A to B to C that they're told what to do, that they're treated as if they have some brains, that they have to figure a few things out for themselves and how to get a task accomplished or something like that. I think that those are probably the best environments. Those don't always come up as often as they should though. In my classes as well.

I: Do you like working with large groups of students or do you prefer smaller groups, that kind of thing?

T: Depends upon what we are doing, I guess. There are certain situations where when we do the labs, I specifically put them into smaller groups so that we can walk around and sit down with a lab group sometimes and just talk a little bit about what they are doing. Generally I prefer if I am doing a lecture, I don't prefer 5 to 10, I would rather have a full house. It's much more comfortable. I guess a full house I should never let anyone say that. Certainly not over 35 though.

I: You know, I would like to explore with you your writing. How did you get into your writing. How did the very first.. the lab manual was your very first effort, was it?

T: No, the issues book was.

I: Oh that's right. The issues. How did you get into it?

T: Ahh, it's funny because I remember I think it was two of us. I think it was (name of teacher) that sat down with me or you sat down with me. It was you and we talked about writing and I said, "I don't know if I really want to write." And what happened is that I sat down with a guy by the name of Bill and he asked me to look at the manuscript that actually (name of education official) suggested that I take a look at. Bill said, "Do you like it?" And I said, "Yeah, it's good." And he said, "What's wrong?" And I said, "Well, it's basically your..It's a one point view. Once again the ecologists are the good guys and industry is the bad guys. And all the student is doing is reading." And he said, "Well how would you change it?" And so I gave him some things that would help sorta fix it up as an end product. Now it was already finished at the time that I suggested that. Let's do some of that. Let's insert some of those controversial issues and let's insert an interactive debate and some lab activity that would stimulate some student interaction. So we did. From there, I was called in again as a consultant on a lab book that wasn't

very successful and it was decided to end the project. And (name of teacher) and I were asked if we wanted to initiate the new project and we said, "Yeah!" I guess from there..laughs I decided that I wanted to do something in general science and technology; something that was beyond biology because it was new and exciting and it was about three years..three years ago now. And that was before the provincial government had a scope and sequence and (name of education official) was working there anyhow. I talked to then president of GLC and sold him on the idea and in about 20 minutes he said, "Let's go for it!" So that was it!

I: Here, you know. I don't mean to be critical or anything. But what is it I guess, about you, that makes you feel like you really have something to offer teachers in what you are writing?

T: Cheryle, you don't know that you have and I guess, the fact that the lab book has been well received has helped. But you know until it went out and there were a lot of corners and I got a lot of flak and anytime that you put something on paper you get..

I: Ohhh! Don't I know it!

T: We've both been there! You get more criticism than praise! And I don't know I guess some of the praise..and maybe the belief that it was better than some of the stuff that was out there. And that was a personal belief. When you write something, as you know, you become very close to it. And it's taken me..I really have to work on not reacting to the criticisms.

I: You have to work on a thick skin.

T: And you have to work on not over-reacting to the praise because sometimes the praise is tempered with political intent and things that..it's not really praise that you are getting but you are getting set up sometimes. So it's been a real learning experience and I don't know..I mean I still have doubts when I put things down on paper and I have doubts until I try them in the classroom.

I: You try most of your stuff?

T: We tried everything that was in the lab book. Every single lab we piloted here and we piloted in..in fact every single lab that was in there we piloted in at least five different schools. So it worked here and in other schools and I found some that had worked well once and when I went back it didn't work well, worked well, didn't work and you know, it's one of those things. Sometimes you don't know why it doesn't work and that is frustrating.

I: You know today, or in our present time, you get things like *Nation at Risk* and you get the *Secondary Education Review* and everybody is knocking education. Do you think there is something wrong with our education system as we have it today?

T: Well is it as good as it might be? The answer is no. There is room for improvement. Do I think it is an advantaged teaching system? No. I am pretty positive about a lot of the things that happen but there are certainly pockets that need a very major shakeup.

Unfortunately I don't see the money often going into those particular areas.

I: What sorts of areas?

T: Well I would certainly think that teacher release time is important especially at the elementary, inservicing of teachers, getting them out of the classroom. Some teachers do the same thing day after day after day. Ahh they don't have the opportunities to go to Toronto or Newfoundland or do some writing. They were once very good teachers and it's maybe a lack of recognition, a lack of direction and motivation to get them going to sort of get them off their butts to start them doing some new curriculum design themselves. They become comfortable and I see that as a problem. I think that money certainly has got to be spent in looking at raising the quality of the individuals that are there. And unfortunately when they go to putting money in there it is all into evaluation. It's all into let's get rid of the bad ones rather than look at what happened to them along the process. Why are they despondent? Why aren't they doing anything that is interesting, innovative and exciting? And sometimes you find that they tried something and somebody just jumped all over them because it didn't work. And you know, I think that's the biggest thing that I see wrong with the education system is that people that have talents are ignored and they are placed in the classroom and their strengths are not drawn upon. And they are placed with the kids and the decision-makers are not with the kids.

I: And maybe haven't been for an awful lot of years.

T: And haven't been. I'll tell you the biggest problem that we're having right now in education is a lot of the administrators are professional administrators. They are not teachers. And that is Edmonton Public and Edmonton Catholic and Calgary and the whole works. There are people that are in administration that spent fewer than one year in a classroom. They became guidance counsellors, as a good example and there's nothing wrong with guidance counsellors, but they don't understand the day to day year to year pressures of teaching. And you know, your first three years everything is rosy because you're learning and it's exciting and for some people what's it like after 10 years? It's very demanding and they start relying on things that worked previously and there is very little encouragement for you throughout the curriculum development. They become comfortable, stagnant, and they are on a decline. And I don't think that a lot of the administrators know that. Because a lot of them are people that have placed all their energies into becoming administrators. Not curriculum designers and I think they understand people in the aspect of sorta dealing with people on a one to one basis or interpersonal relations but they don't understand education. They don't understand curriculum design. They don't understand why people should be called upon, what their frustrations are, why they harbour those frustrations but they know how to schedule them into lunchroom supervision or they know how to keep the ship quiet so that there is not a revolt. So their interpersonal skills are often very good. They really don't understand the pressures that these people are facing and don't provide leadership and certainly not curriculum leadership. So that is the big problem as I see it.

I: Do you think that we are adequately preparing our students to face the world that they are going into?

T: Because it is changing so quickly. People are always talking about the fact that.. you

know, are they going to be prepared for what we don't know what's going to be out there. And I think to a large extent the answer is "Yeah, I think we are." Ahh if a student is a serious student and takes advantage of what is presented, the answer is yes but there are all kinds of kids that don't. And leave school and they don't know how to read and they don't know how to write and balance a cheque book. So for them the answer is obviously no. I don't know if it is the school or the system or the responsibility extends beyond the school and the system and maybe to the home. Ahh...It's a double pronged thing.

I: You see, that sort of leads into what I was going to ask you next. You know, just in the last month, the big splash in the newspaper about the number of kids that are illiterate. Why are kids going through our system and why can't they read and write and comprehend when they complete Grade 12. A lot of them are able to circumvent the little checkpoints and get by it.

T: Well I think that we live in a democratic system and one of the problems with a democracy is that you're limited in what you can enforce and there were all kinds of kids in junior high that attend school two days a week. They don't read very well. There are all kinds of kids in high school who are on the books and their parents will actually reinforce the fact that they don't have to be here everyday because they are working late or they are doing a lot of things and yeah we attempt to keep them in because we feel that even at three days a week it's better than them working in a car wash.

I: Or nothing at all..

T: or nothing at all. So they've floundered through. You can't fail kids in elementary school unless their parents agree with their failing. So there are kids that are promoted that don't read. There aren't enough resources - economic resources - for resource rooms and to get them caught up. Unfortunately a lot of the reason that they fall behind early, in early years, I think is that there are developmental lags. In later years it's an attitude and there's an opportunity. I've seen situations where kids were in resource rooms in Grade 3 and Grade 4 who are honors students in high school which tells me that if you don't read very well in Grade 4 because it's a developmental lag; the opportunity is in the school system to catch up and it may take some work on your parent's part and it may take some work on the student's part that is beyond what they're receiving in the classroom. But the whole onus for education isn't on the school. I've seen people who come into high school with a strong background in elementary school who begin to slide in junior high and they accomplish very little and their skills actually deteriorate rather than advance and simply because they choose the courses that provide the least resistance for them. Nah in many cases I really think that the onus goes on the individual and not on the system.

I: What do you use as the main determinant of course content and way of instruction and evaluation in the courses that you teach?

T: Well course contents, you at least use outlines set by Alberta Ed. And I do follow it. I modify, like everybody else, and emphasize things that I am more interested in and that students tend to be more interested in. Ahh, I guess the presentation is appropriate sometimes the supplies, the equipment. I prefer the laboratory approach whenever possible but I recognize that it is a very time-consuming approach. And you can't do a

100% lab course and ever get through all the material. I hate saying that because you know I think of the individuals that say "I can't do labs because I'll never cover the course" and that is not what I mean at all. But there has to be a balance and I try to provide that balance. I usually look at least 40% on labs.

I: OK, like in your presentations you use the lab. What about your lectures and that kind of thing. Do you use a particular textbook or is it a mosaic of your background?

T: It's a mosaic and a lot of it is interspersed with questions. I think you've seen that today.

I: Certainly.

T: And I'll stop and give them time to think and sometimes it slows the whole flow down but that is important because they have to gather their thoughts. And sometimes it makes for a less exciting looking class but I think it is a more meaningful class for the student because they have to go back and synthesize on the spot and put some of the information together and call on the previous day's information. It helps to key them into particular things that I want to do in the lab. A lot of the questioning and demonstrations that I do are set-ups for things that I'll be doing later too so it's ..

I: I sensed in your class, and again, my perspective, but I sensed a feeling of excitement when you gave them the question and they worked it out and they got parts of it right but they didn't quite get the whole thing and I could actually feel an excitement from them that was being transmitted and it was a nice feeling.

T: It was a challenge. Throw out a challenge and see what you can do with it.

I: Do you do that a lot?

T: I do that an awful lot. In fact we run..I give bonus marks all the time.

I: How do you keep track of these bonus marks? I mean this is a very pedantic type of question!

T: Oh no! It's actually makes a lot of sense.

I: I thought that maybe you were just saying "Ah this is a bonus question." I didn't realize that you actually give them bonus questions.

T: NO! No! (Name of student) got the bonus marks. OK This is a 20 class and these are their assignments to now. They have got only one bonus. They've actually got another bonus that I haven't got back to them. They had to figure out the murderer from a genetics problem.

I: Oh, I see, that's why you actually had them hand in the stuff..

T: Yeah, yeah.

I: And then you mark it and then give them the bonus. Oh, OK.

T: This is the 30 material and these are their assignments but you'll see lots of things written in columns like 0, 2 0, 2. Here's (name of student)'s which is 0, 2. She got 1 there. And then on the next page she has another bonus mark over there so the opportunity to pick up 3 or 4 bonus marks as they go exists. It doesn't work out to a lot. We are looking at probably 3 marks out of about 570 marks well even say 10 marks out of 370 some or 670 or 10 marks out of 600. It doesn't really change their report card mark but I guess there is something attached to it. Ahh some of them don't need it and some of them do. It kinda shakes them along and gets them motivated for awhile.

I: That was neat! But I didn't realize that you actually gave them a mark. Do you give them a bonus mark for asking super good questions or anything like that?

T: No. That is an expectation. That they ask good questions and I'll compliment good questions but no..

I: Yeah, I noticed that you praise them a lot. Like there will be a question.. an answer perhaps, or an attempt at an answer that is 99% wrong but you'll find that 1% that was right and compliment them to make them feel good.

T: Well yeah, and it depends on who it is, too. I mean that there would be some that would be devastated if you say "No, you're out to lunch." I mean I'll do that on occasion and it will be with somebody who has a lot of confidence and I'll say, "No, you're wrong." And they'll smile and I'll smile but the interaction is the smile.

I: Right.

T: And they should learn to accept that too. That at this point too we are doing a little bit of guessing and a little bit of synthesis. They are not expected to know all of it so..

I: OK. Thanks a lot!

END OF INTERVIEW

APPENDIX C-3

SECOND INTERVIEW WITH TOM, NOVEMBER 4, 1987

T: Actually you should have more then enough information out of this round because

I: Well, you mean in terms of observing or what?

T: Yeah, observing.

I: Well, hopefully. I do have one more teacher scheduled that..

T: No I mean from me alone you must have tons of stuff.

I: Yeah I do. And certainly when I went through my notes I got a lot more questions than I thought I had. So you know I think that I will probably be OK. But I probably, I don't know, I'll maybe shut down the 30's after awhile and just simply come for your 20's until I see sort of a completion.

T: The interactive debate.

I: Yeah. Yeah. Cause I am really looking forward to that. You feel much more comfortable with me in the class now?

T: Uhh. I suppose so.

I: You are still quite aware that I am there and that I haven't blended in completely yet.

T: No and..and..but a lot of it too is that I will..I have sort of a relaxed style in many aspects and will tend to draw other people into conversations anyway. And I have been trying not to do that so I guess I have been conscious about not doing it. I do that with student teachers when they are there and I'll say, "Well what do you think too?" And I know that is distracting for you. There is a tendency that makes me want to draw you into the conversation when we are doing labs and to get you to interact or encourage you to interact with the kids and yet at the same time I know that you are there for another function and that's distracting. It's sort of a dichotomy. It's not my usual style so I..when you do have somebody there you react differently to an extent. I mean, a lot of days you don't. You use resources and resource people that are there. It's a natural thing.

I: Sure. I was just sorta wondering cause I know it took my other teacher a long time before just completely ignoring me. There was a blending. I sorta felt this week that was beginning to happen in your class.. That there was a blending. I was there but just sort of an artifact type of thing. The other thing that I sorta wanted to talk about right now was all this paper work. It's really.. I noticed for example that you seemed to ignore doing the attendance. That must be a policy that you have in your school and quite often you come in..and I sort of thought that you're chomping at the bit -"Hey, let me get at

this teaching!" and you have to do all this paperwork.

T: Yeah. No. In effect we are just the opposite. I'm in a difficult position here because you can see sometimes I am starting one thing and I'm also starting something else down the hallway. Yesterday was a good example. They were doing an English exam. It's a system wide English exam that I was coordinating in the school so I had to have teachers in the room and I was coordinating that. I had to have the exams in the room and that means different exams in different piles with the student names already on so we had to go through the entire list and separate them from an alphabetical list to a class list into the five class lists, make sure dictionaries were there, make sure doors were open. (name of laboratory aide and secretary) does a lot of that for me too. Without her it would be tough. And yeah.. there were reports to fill out yesterday and then I had to drive the stuff down to central office. I got different curriculum guides in on Social and English

I: Have to be distributed..

T: No. And it's a reaction and has to go back to Alberta Ed and for Science and for Mathematics. So I have a Mathematics meeting tomorrow. So again I was coordinating. For example (name) was doing a presentation tomorrow to the Math Department on the Junior High Math Program so I had to make sure that he had all the resources for that and (name) in the Academic and (name) in the Nonacademic so..and then I have to be there as a coordinating person. So that occurred yesterday as well as occurred for Science and yeah...we did some ordering yesterday too in science. And two teachers weren't here so I had to make sure that the subs were in the rooms. And make sure that they turn the keys in and those kinds of things. So, yeah there are days that I would just as soon do the teaching. There are a lot of days that there are some tremendous advantages in my job and there's a tremendous potential to learn a lot about other areas and mostly I am still in the learning process. But there are days that I find my time very short. And I don't teach much less than an ordinary department head. I teach 5 out of 8 and so when you teach 5 out of 8 blocks you don't have the time to do a lot of the things that I am doing. So I don't want to sound like I am complaining but ..

I: No.

T: So I would just as soon get at the teaching a lot of the days!

I: That was sort of my gut feeling just watching you. Your face lit up when you got into the teaching and then have somebody knock on the door and you know - is the attendance done? - and then sometimes you just quickly look and "They're all here!"

T: And some days I'm not accurate and that's really not a good way to be but I mean it's a compromise and I'd rather compromise that end of it than the teaching end. And I do compromise the teaching end more than I used to. I mean there are all kinds of compromises that I make for time. I've got meetings probably 3 out of 5 days a week now.

I: After school?

T: After school. So I can't bring kids in after school like I used to when I was just a science teacher. Ahh. I coach too and I write and every once in a while I feel like I'm wearing too many hats. And I get..I guess it keeps you interested because there's not a thing that I'm doing that I think is negative. I think it is all positive. There are times that I..

I: You just get tired?

T: Yeah. I just get tired and there are times that I would like to say that I would just like to mark some papers. I almost never get a chance to mark anything in school anymore. Ahh. All my marking is done at home pretty well cause when I am here I have more things to do and ..

I: And it is stuff that you can't do at home.

T: Yeah. And the other thing..And I haven't had much of this year, Cheryle, but most of my job is making sure that teachers don't get on each other's nerves and on each other's back. That may sound silly but a lot of my job is to make sure that resources are well managed, especially in Social Studies, where our Resource Unit A for Social Studies, for example, will be used by four different teachers and I've got to coordinate times and I've got to make sure that my English novels are in. English teachers especially are..I guess it's the marking that you do..but they have a tendency to square off every once in a while.

I: Trigger-happy sometimes?

T: Well..Yeah..and I guess I am a buffer there. And a lot of that is just that.

Interruption..

I: OK Now on to the mundane things! I was wondering what you used as a basis for determining course content? Besides the curriculum guide. You know, like for example

T: Changes!

I: the callous stuff I mean, that is not on the curriculum. Is it just things that you encounter in your writing or books that you find..what do you use to sorta determine..

T: Every unit has something new..

I: Yeah..

T: And I guess that is just it. But I guess it is curriculum.

I: Oh I know it is curriculum but I mean you don't use Berry, for example, to determine the content of your Bio 30, you use the curriculum guide as your loose overall ahh..guide, I can't think of another word. But what else do you use that helps you to determine your content?

T: I guess what it is.. is as you read and I read a lot.. you pick things out. I did the thing

the other day on aging. I thought, "Geez, this is really neat!" That aging, and sperm cells, and cancerous tumours..there is a relationship that is found in research. I thought that it was exciting and so I told them about it. And I related it as best I could to what we were doing so it wasn't something out in left field. I guess it is just that. If I find something that is interesting I want to tell them about it and usually if I am genuinely interested in it, I can develop some interest in them so a lot of stuff that I do isn't I guess you would put quotations around it "core content" but it can become core content because you can use it to support your core content. The look that I give DNA is very cursory compared to what a lot of teachers do. I know teachers that really go at it. And I give them, I think, an adequate understanding of DNA. But I don't hammer home facts that you would get in an IB class.

I: There they would have to know the difference between a purine and pyrimidine and you know, how they fit together and what the bond is and all this kind of business.

T: Yeah and you see I'll bet that the kids that do the project for me are going to know this. They are not going to know it because I taught it to them. They are going to know that and they are going to know more about DNA, I believe, than the average kid out of an IB class because they will go to the library and they will take out books. I mean you saw that today. Ahh and maybe they won't learn every detailed..well all the detail that you would in an IB class and what an anticodon is and some of that stuff but they are probably going to remember a lot more than some of the kids that are just doing a lot of content and a lot of notes and not that that's bad but they are going to learn a lot of things that they find are interesting. And they are going to remember them because they find them interesting. And I guess it is sort of a different view of what's core and what has to be there. And the other thing in my class is that there is going to be a tremendous range in what kids know. Some of the kids are going to come out and probably not even know the basics and obviously they are going to fail but I would say that there is another pocket of kids that sort of knows pretty well what you would find in every other Bio 20 class but I would also like to think that I make available that opportunity to really go into something and you know, this year it is genetic engineering. Last year it was snow ecology. The year before that it was water quality. And all of those things become part of the curriculum.

I: OK. Ahhh.. Why do you have students do labs? You have already told me that you think they are going to do more.. well in terms of the projects they are going to do more reading and that kind of thing. What about in terms of the labs? You said you did an awful lot of labs. Why do you..What sorts of things are they going to get from them? And why do you do so many?

T: Well one of..I guess it's just sort of an overall philosophy. One of the things that I said is that they learn a lot from each other. And it provides that opportunity. They question and they look at other people's results and they want to know why they are different. They want to know how somebody else can be right and have different results than they do. So they become critical thinkers, I think. Or at least it provides the opportunity to become critical thinkers. It is not a lot of things that pay off on exams; you know you can say that the things that happened maybe make them better scientists. I don't know that that's true or not. If it's all in what we consider a good scientist to be but I guess that's number one. The other thing is that it is a change of pace. I mean, to have

somebody lecture to them day after day after day overhead after overhead..I find that hard to take myself. And even if the person is a good lecturer, there are days that you just don't want to listen. And they are kinda immature still so they are not going to want to listen to me everyday. They..they have to do a lot of tedious things that I never used to do. I do more worksheets than I used. I do probably more exams and I guess I won't compromise on this. You know, I don't teach it the same way that I used to. It was a lot more open and if I didn't cover a unit it was OK you know, but not now..

I: And it's because of the diploma?

T: Sure it is. We have all modified our teaching because of it. There have been some good things, I guess. There have been some negatives. And I think that the negative is the fact that I've got a sort of internal clock saying I've got to do two weeks of review and two weeks of review is like watching the paint dry. I mean it's..it helps their marks. It's actually not two weeks. It works out to about six or seven classes but really it takes about seven classes to prepare them and put it all together again and go through it. It does show them how the different systems are interrelated but it's not great. I mean, I used to do one lab and then somebody would say, "How about this?" And I would say, "Let's do a lab. Let's figure it out." I don't do those things anymore because I just don't have time. If I start doing those things I would never get through all of the content. It it's still tough to do. What I am also finding now is that the diploma exam is asking more and more in the way of specifics and I think less and less in the way of critical thinking. And you and I both know that you can teach concepts and application and understanding really becomes knowledge if you do enough of these type of things. And I guess I'm in.. in a quandry because I don't want to go all that way but I have succumbed to some of it because they need the marks. And I mean to have kids have a wonderful learning experience and not have the marks to get into university.. Am I doing a favour!? Laughs

I: Actually (name of student) had some interesting comments. I thought that she might have been a repeater but I wasn't sure.

T: I didn't know that she was a repeater.

I: She is a repeater. And she came from another school. She was talking about the comparison of teachers. Yourself with the other teacher. I happen to know the other teacher.

T: I don't. I don't know what school she was at.

I: It was interesting because this other teacher probably gets..He's one of the very high diploma type marks. She was talking about the kinds of things that you are talking about. What she was getting out of there and what she is getting out of your class are two entirely different things and she was actually..I mean, this is a grade twelve kid and she was picking them out quite nicely and just laying them out for me while we were talking today. It was really kinda neat.

T: You should be interviewing her!

I: Yes, I was wishing that I had my tape on! Pause Do other teachers do the same labs as

you do in your school?

T: (name) does a lot of the same labs as I do and (name) is starting. Ahhh.. there has been a tremendous growth, I guess, in all of us here. But she was very much an overhead - AV person. And she is doing a lot of labs now. Certainly comparatively and she does a lot of the labs from my lab book actually. In fact they want to use the lab book but it's not approved yet so I have been sort of soft-peddling it and trying to say well, maybe just duplicate just what you need but..

I: Rather than buying it?

T: I guess, we are going to get some.

I: Do you..In terms of deciding what you teach is it pretty well an independent type of thing then?

T: No. In that we follow the curriculum but we don't lay out specific labs. The reason that we don't is because I don't want to follow specific labs every year.

I: Yeah. You want to vary them.

T: Yeah. I want to vary them. And I don't think it's anybody's prerogative to tell chemists - chemists that - Our chemistry teachers follow Alchem so they do much the same thing probably more so because it is more..

I: Because it is laid out.

T: Because it is more laid out. It is more structured for them. Biology - No. Now (name) and (name) are doing the Bio 10. And they did pretty well three bacteria labs which were all the same. They were from my lab book. But nobody said, "Do these labs." Or would I ever want to.

I: When do you guys get together to talk about stuff? Like I have never seen you talk together at noon or anything like that.

T: We do it really informally.

I: Sort of as you pass in the hallways that kind of thing?

T: Yeah! A lot of that. We don't have sort of a lot of organized approach in that I think we have some organized ? and stuff and some organized direction. We do common exams at the end.

I: But not during the year.

T: No. We are even starting to move away from those because we were finding that that they were very confining so now we are going to more common blueprints and developing exam banks around that. I think that the common exam sort of got us together and got us discussing. But we do, you know, we do discuss things. (name) and I are doing the thing

on cloning and (name) doesn't have the 20 now so for example when she does the 20 next semester she is talking about doing some cloning experiments. But..in fact she has asked me, "How do you do this?" And I said, "I'm finding out! I really don't know!" I don't even know if it works. But those are the kind of things that we do and a lot of times it'll be things that they'll pick up from students. And they will say, "Hey, can we do this lab?" And somebody will come or I'll come to them and there will be an exchange on that but there isn't sort of a concerted effort to have..and I think that is good. I have been in the other situation where they wanted everyone to do the same thing on the same day..

I: That's really confining..

T: Ahh it's confining. You don't allow for different teaching techniques. The other thing is that the Catholic schools, the Bio teachers in general, you may have one or two in the school and some of the biology teachers (name) and (name) for example were the only ones basically at their school so to bring them into a situation where you are now forcing interaction can really be negative so..

I: Oh right.. You always dress immaculately - the shirt, pants, the tie, that kind of thing - why do you do that?

T: I don't know. I've never really stopped to analyze it. I guess it's a feeling that I don't want to look like a bum! In front of them, maybe. Aah, Yeah I do. I wear a tie most days and I wear a sports coat.

I: Or a dressy sweater a couple of times.

T: I don't know. I guess it's...

I: Does it make you feel good?

T: Suppose it must. Sure I like good clothes. Laughs And I like to dress but I'm not..I could never be a grad student in zoology with the coffee cup and the sweater with the thousand holes in it. But I don't know I guess I started it, Cheryle, when I was a beginning teacher and I didn't look very old. I was teaching at (name of school) when most of those guys were shaving from Grade 7 on.

I: They looked older than you did!

T: Well some of them were. The first year that I taught I was 23 or 22 and there were guys in my classes that were 21 and boy they looked a lot older than I did. And so I put a tie on so that they would know who I was in a school of 2000. I'm in the hallway, 22 years of age so that was it, that was the reason.

I: Going to more profound things here! You gave assignments for homework. Why do you think that is important?

T: I think there has got to be a commitment that they make beyond what we do in the classroom and I think that is a..certainly a commitment that they are going to have to make down the road be it a science class or any other kind of class or a job that asks for a

particular responsibility. You know, so I think number one that is certainly a reasonable expectation. I guess the other thing is to attempt to cover everything in class. Means that my class has to be so incredibly structured that we don't do anything other than strict content so when I do some of this extra stuff some of the responsibility falls on them to do some work at home. I would think that that would be the case for most high school classes.

I: Today for the first time I actually saw you checking some.

T: Ummhuh.

I: For the 20 class. How do you know that it is done?

T: I check for the 30s on occasion too. And I'll take off marks if I catch them twice and their homework is not done. That's what they were talking about.

I: Oh that was the one chance that ..

T: That was the one chance and I keep a record of it and I'll dock marks pretty liberally because I feel that I make a commitment and I feel that they have to make the same commitment. Everybody forgets once. I mean there are days that I am sick and I can't get a lab done, corrected, so I am willing to accept that but they have got to recognize that I am pretty relaxed about lots but that there are limits and it's a good way of defining the limits. I am still the teacher. I'm not their buddy. I'm not their friend. They recognize that and that's why I wear the tie too, because I am very informal. And it's a dichotomy. I've never had the situation break down and I think that it's probably.. is that they still recognize that I am the teacher.

I: Have you ever had the problem of -or I don't know if it's a problem - of them wanting to call you by the first name?

T: No.

I: Yeah, cause I noticed that they are quite formal with you. Mr. Selleck - there is no question.

T: No in fact never in the school other than someone who has graduated and comes back and says it for a reaction. I dunno! I let them. But no, in fact they don't even feel comfortable with that. It's funny. All the students that..one guy is a doctor - I think I told you - and he said it still felt funny calling me Tom. Laughs And he's a physician. So yeah I guess it carries over.

I: It's that line that they don't cross.

T: I respect them as students and they respect me as a teacher I would think. So..

I: You use very few handouts. Is there a reason for that?

T: Yeah. Big kids don't read them! I really do! I think that getting kids to read more

than what is in the textbook; you're kidding yourself. In most cases, unless they get going on a particular project and they want to read it. And I don't think you..handing stuff out is going to make them do it. I think question sheets are different because what question sheets make them do is review their notes and review what's in the textbook. But you're not going to get kids to read articles for the most part. I used to do a lot of things from *Science Digest* and *Discover* and bring them in and what I was finding was that for every kid that would read them 10 kids would throw them in the garbage. And you know, I used to think that more of them read it and of course you would get the reading from those that were super keen. And what I find now is that we do a library orientation session and we do a good library orientation session and the kids in the school use the library like no other high school in the city. And the kids go and you saw some of that today and we don't have to tell them to go and look something up.

I: So they simply go in themselves.

T: Yeah. And that's the way that it should be too.

I: So the only kind of handouts that you use are like maybe diagrams for practice and question sheets and that kind of thing.

T: For the most part. I occasionally I've got a couple of ones on future drugs that I do hand out that some.. very occasionally I incur research but I may end up two or three a semester but that's it.

I: Well since I have been here and that's been quite a while it's been very few.

T: Yeah.. I haven't handed any out. I did hand one out before you came and that was when we did meiosis and mitosis and it was looking at meiosis and it was an article on nondisjunction and Down's syndrome and it was a one page article. And it was just speculation on why older women and of course it was just a theory..it was really three different theories that they were examining and I wanted them to recognize that science doesn't always have the answers and that a lot of it is theory and speculation and then testing and validation and those kinds of things. That was the article. But that has been it since the beginning of the year.

I: I noted that..and I guess it sort of goes with your relaxed attitude, you're not very stringent about lates or that kind of thing. Do you have any policies about lates?

T: Yeah. Most of the kids that come in late, don't do it as the..(could not decipher) probably see them. The bell goes and there are two bells here. It's tough moving through hallways in the school at the best of times cause the hallways ..

I: Yeah, cause they are pretty crowded.

T: and if I'm under the impression that someone is abusing it then I'll talk to them and my morning class is not in. This class that you've seen, the third block, isn't too bad. Aah, the morning class is bad and I've talked to some individuals about coming in late but I won't do it in front of everybody.

I: It's a personal thing.

T: It's a personal thing and every once in a while when somebody comes in late I'll start asking questions of everyone that comes in late and that's kinda subtle way to stay at the door until they answer the questions so..but that's when I am starting to get annoyed with them and they know when I am getting annoyed with them. But no.. like the girl that came in late today I could tell that something was wrong. The worst thing that I could do is stop the class and..

I: Well you certainly didn't. You just kept on going and the kids hardly even noticed that she had come in late.

T: I wanted to know if she was OK cause she looked upset.

I: Yeah. I think that I sensed a slight feeling of guilt within yourself when you were absent those two days. You felt guilty about being away from the class. But yet I know that in your job as coordinator you are the first one to give release time. Is there some dichotomy there maybe in terms of your roles or maybe in terms of your beliefs?

T: Well .. I'd just as soon be in the classroom as away. There were some good things and some bad things happening when I was away. I wanted to give them an exam before the reporting period so I felt guilty about the fact that I wasn't there to clear up some misconceptions and I knew that there were some sort of feelings of disequilibrium and I was asking them to be responsible for a lot of it. Now in some aspects I knew that that was good too but I also knew that some of the weaker ones were stuck.

I: What do you feel you're accomplishing by your strategy of always asking questions of the students and giving them sort of application type problems where they have to use what you have talked about before and that kind of thing. What do you think that you are accomplishing with the kids?

T: Try to keep them awake for one thing. Laughs It's amazing if you just ask them recall questions, only the one that gets the recall question thinks. The other ones don't because it's a recall question so it isn't personally-relevant to them I guess. Try and get them involved but I think beyond that is demonstrating a reason for the information and the reason is more than just answering the questions. It's application and sometimes they come up with application questions and so for a physiology program to be a good physiology program I believe it's got to be application oriented. I don't like teaching Bio 10 very much at all and I find that Biology 10 for the most part is a waste. It doesn't have very much application. It's a survey. It's a lot of facts. Even the dissections and the things like that that the kids enjoy doing are really limited. I look at the time that's put into Biology 10 and what's accomplished and I don't think it's a great program. In fact if I had my way I'd throw out the survey and do it a very different way.

I: Maybe you can do it in junior high.

T: Yeah do it in junior high and go into ecology. Apply the things. Cause, they don't remember anything. You leave that stuff and all that they remember is that there was a whole bunch of things that had a whole bunch of Latin names.

I: And they usually remember the dissections. Do you remember that frog that we did?

T: Yeah, yeah that they remember. But that you could do in terms of comparative anatomy and look at comparative systems. A comparative systems approach rather than a phylogenetic approach would be a far far superior method.

I: So the sort of thing that they do in Ontario in other words.

T: Yeah actually I can see some advantages. Unfortunately Ontario doesn't do it in a very innovative way either. Their's is a real classical comparative anatomy without sort of looking at the adaptations. And I would really stress the adaptations and the ecology and those aspects much more so.

I: You described yourself as..and this has been several times..you described yourself as a low key type of guy. What do you mean by that?

T: I'm really not in some respects! Well I guess I don't rant and rave. I have a low boiling point. I don't get upset with students very easily so in that respect I am lower key. It takes more to rile me. A lot of times I realize a kid comes in and puts his head down on his desk that they are not defying me; they are just tired. And there are people that I think of as being keyed up that would react immediately to that. So I say that I am low key, that's what I mean by it. The fact that I am low key is..at least I would like to think that I am but as far as being low key about my teaching -no.

I: No! You're quite flamboyant! Today's lab was perfect! Laughter

T: It was.. And I have fun! And so I am not low key in that respect.

I: Right.

T: And I would like to think that I am enthusiastic and..and..I mean I do a sales job on kids too. I try to get them excited about it and get them reading about cloning and stuff like that. And that's not low key. But low key in other aspects. When I coach I am low key.

I: That was another..

T: I would never talk about beating another school. We don't even talk about that. We don't allow that in swimming. We have not lost a swim meet in two years and we report to the school that we won the swim meet and we report the points. But that's not what we talk about. The swimmers are not even allowed to talk about the fact that we had 350 points..

I: It's how well they did.

T: It's how well they did and how their times are improving and those kind of things. We absolutely will not let a swimmer to get out of the water till everybody else is finished the race and they have to shake hands with kids on the other side and so it's not us beating them.

I: Sportsmanship and citizenship.

T: Well yah. And that's why I don't like this body count and that and I know..to me it was a student being immature. And if (name of student) would have heard that, he would have reacted the same way. And you could see that there's sort of a different type of.. (name of student) is a good kid so there was no sense in reacting to (name of student) because and it's not the coach either. The football coach is a pretty good guy. He's not "Let's go out and kill them." He's not let's go out and murder them. He's not.. the sport encourages that kind of an attitude. And (name of coach) is not the beat on his chest and ___ the kids and scream. It's a different .. it's a different focus I guess.

I: Right. How do you go about making students feel good about themselves? I know that was one of the things that you said that you liked to do. How do you go about doing that, though.

T: Aah sometimes you just have to sit down and talk to them on an individual basis when they are not doing well. I did that yesterday actually with one girl who came in to see me. Aah she was really getting frustrated; she wasn't doing well in biology. Sometimes you just have to tell them that because they are not doing well now that doesn't.. that they won't do well in the future. It's a real misconception that we have is that kids that do well in high school are going to be good biologists or good students. They are just good at that time and there's..it's just like athletics. You can be a great sprinter in grade 4 and get fat by grade 7 and you can't run anymore whereas other kids who weren't very coordinated gradually developed those particular skills and I guess it's for them to realize that there are differences but that those differences change and what's really important is that a person..I really don't know which kid is the brightest kid and I hear a lot of teachers talking about so and so is really bright. Well they may be really bright but there's probably a lot of other kids that are equally as bright and I don't really think we know who's bright and I think that we can give an evaluation based upon you know, content and it reflects their..their..at least understanding at that particular point in time. But to tell you who is really bright and who isn't, I have no idea so I guess it's.. It's that understanding and to try to transmit that we all have different skills and different abilities and that we all struggle in different things.

I: I noticed that you said to one of the Biology 20 students, I think it was (name of student), it was during those genetic problems, you said something to the effect that we'll work it through together later. When does that working through actually happen?

T: They'll come to me.

I: So it could be during class?

T: Uhhuh.

I: Not very often after school because of your other commitments.

T: No. And sometimes they'll figure it out as we go. But I can see that every once in a while there's sort of a block there and you know what the block is but you don't want to stop 30 people and provide that kind of a focus. Come on in (name of teacher), it's OK.

I: Do you want to continue or should we call it a day?

T: Sure it's OK.

I: Cause actually I've got more questions here and I am not sure that we are going to get through it cause you..

T: It's alright. Let's keep going.

I: You quite often use the phrase "Does that make sense?" And you sort of look at..sometimes it's a group, sometimes it's an individual. How do you get your answer? How do you know that "Yes, it makes sense or No, it doesn't make sense."?

T: You don't always. Sometimes I am filling time. Laughs But a lot of kids will honestly tell you, "No it doesn't make sense." So for those ones you get an answer. Other ones say "Yes" but they say yes hesitantly. And so then you ask them a question.. Aah sometimes you miss the reading but every once in a while I will stop and maybe it's not the kid you're looking at and someone else will say, "Hey it may make sense to him but it doesn't make any sense to me." That's happened. And so I guess it is just asking - providing the opportunity and then if I'm on my toes and am doing what I'm supposed to I will usually try to come back and ask something throughout the lesson to sort of verify whether or not it's true. But I don't always.

I: You often have students come up to the board and this is particularly true with the genetics stuff but of course that lent itself so nicely. But you have them come up to the board and put the problem on the board. Why do you think that is important?

T: Well I think that it is the aspect that it is not just me who gets to write..I ask kids to do explanations on different things in physiology too. I don't make them stand up cause I would hope that they speak loudly enough. In genetics you have to demonstrate on the board cause you can't talk about those things so it's ideal to use the board. To indicate that it's an evaluation technique for me. For them I think it's fairly subtle in the fact that so and so really knows this or really doesn't and where they are having their troubles. Oh, yeah I think that way too. Maybe it's the difficulty that I'm having. You know..

I: So it's an example, illustration, that kind of thing.

T: Yeah. It's for me and it's for them too. I can think of advantages both ways.

I: When you ask questions, you're quite persistent. You don't let them off the hook very easily. Why are you so persistent?

T: I think once you establish the fact that they can get off the hook too easily - you don't want to embarrass them - they just do that. "I don't know"

I: You usually fish out. You usually get some..

T: Some kinda of an answer!

I: Some aspect of the answer.

T: Well I try to. If you go to somebody else .. if you do it continually they ..

I: Turn off?

T: They feel pretty negative about questioning. They anticipate not getting it. And at least if they get one small part of it, I mean, you have restored some of their self-image sometimes. And sometimes when they are really frustrated and they're kinda flailing you do have to leave them and go to someone else because you are just going to continue to increase their anxiety. So I guess that's it.

I: OK. Sort of along the same line, how do you think the students adjust to this questioning, application type of teaching strategy? Cause I'm sure that this is quite different from what they are used to.

T: Some not well. Interestingly, when we wrote our lab book we tried to put some of that kind of questioning into the lab book and of course it's a lot less than what you can do in person but one of the teachers indicated that it was the better students that were having trouble. It was a teacher from Labrador City.

I: They are so used to memorizing.

T: Yeah. They are used to being able to find a definite answer in the book. And she said they were looking to the textbook and it didn't have the answer. They were getting really frustrated with the textbook. And I said, "Well, maybe that's not what we want." And so it's just that.

I: It depends on what the teacher does with their frustrated..

T: I mean, it could be awful.

I: Especially if the book doesn't have it.

T: Oh and the book usually doesn't. A lot of the questions that I ask you won't find the answers in a textbook. And a lot of it isn't and that's the other thing in physiology is that it isn't the whole story and I have to start somewhere. And I know that to an extent I am probably creating some misconceptions but the misconceptions will be cleared up I think as they go along.. at least a lot of them. Some of them probably won't. And I have come to realize that as soon as you do application and you have only done the circulatory system and you haven't done the nervous system to accompany it, yeah there are gonna be kids that think you can now answer everything in terms of the circulatory system for an inflammation response, for example. I am aware of that and I am aware of the fact that when I talk about histamine it's just one of many things. There are kinins and a lot of other things. But to me that is not really important..it's the process that they are going through. Not that they know that there are 5 or 6 chemicals - the endorphins - that communicate. And for other teachers they don't think. For them it's important that kids know that there are histamines that do this and that something else does that and I can't

really argue that point. I mean they're right that students should probably understand that there are a lot of different things. But to me it sort of comes to a point that I'll gloss over that..This is one of the things but I'll give them something that they can recognize and histamines is an example because it's a name that they have associated with antihistamines so it's a different focus. And I know that I drive some people nuts because they would say..why those kids don't know.. I mean you are getting into things that are really beyond core and you are not really giving them the whole story.

I: You often get them to write..well you always get them to write their answers down and sometimes you take them in. Do you find that most of them attempt the stuff?

T: Yeah they all attempt it..almost always attempt it. To write it out gives them a little more time to organize their thoughts. And when I ask them something verbally there is a pause and (name of educator) is the guy that should talk about this because you know, he feels that a lot of teachers feel that students should have answers like this -snap, snap, snap - and that's not realistic. When I ask them a question, I ask them to write it out, it is less strain than the pause and it is also more time to organize. So that is what that does for me and you need time to organize your thoughts. You don't make those connections instantaneously especially in some of the questions that I ask.

I: If you're like me, I go home and then I make "Geez..!" you know!

T: And kids..most of them do that. And that's the best part of the process too.

I: When you, you know, when you teach you often share a part of yourself with them. You know, like last weekend I did a lot of reading about DNA and genetic engineering. Why do you do that? Or another comment I used to swim..

T: It's probably my unconscious. It's not conscious. I do to a point, I guess. And there is a lot of things that you don't tell them. Laughs for various reasons. I dunno. I've never really sat down and gone through it. They don't know alot about me. I'll give them, "I read an article." or something like that. I don't burden them with my life history. I mean the kids knew that I swim because a lot of them swim for me anyway. We figured out that about 1 out of 10 kids in the school swims for the swim team so I mean, you can't go into too many classrooms and not know that I swim. But actually I don't tell them a lot. They don't know what my kids' names are.

I: Although you do mention your kids..

T: Oh yeah, yeah. I said that they jumped on me and stuff like that but I don't go in and you know how some teachers are and they sort tell them the whole life story. I don't think that kids are all that interested. But if it's something like someone jumping on me or something like that..

I: A concrete example..

T: A concrete example to get the point across really.

I: One of the things that I noticed about your questioning is that quite often you start out

by addressing a particular person.. (name of student), I want you to think about this..and then you sort of concentrate on that particular person. Do you think by doing that, by naming one specific person, how do you think that affects the rest of the group? Or do you think that it does?

T: I don't think they relax. You know, I used to think that you ask a general question and then you go in and you specify. I found out now that because they know me that when (name of student) answers some of it, I'm immediately going to switch so message is there and what I'm doing is that I quite often pick out somebody that I haven't asked Interruption due to turning over of tape.....

I: What the others are doing. They didn't seem to lose their attentiveness. You know, they still seemed to be on task and that.

T: If you ask a.. The other thing I guess is that if you ask a question to the class and I've been in the situation, you can have a class dominated by four individuals or three individuals and then you start to avoid them. And that's no good either because then you avoid the people that are most interested. That makes no sense so I'll come out and just ask a particular individual and I'll try and move it around. There are probably some.. some kids that I am a little easier on because they may have a speech impediment or a language difficulty but I won't avoid them completely.

I: Right. Yeah. I noticed that you do move it around. You know there are some kids that, I think, if I went back through the tapes, you ask more questions of than others but I think that you have covered just about every kid in each of the classes.

T: I try to.

I: When you were discussing the Bio 20 and you were discussing the idea of cells..chicken cells, ham cells, lettuce cells, you know that kind of thing, yogurt, yogurt is a favourite!

T: They really like that one!

I: Yeah! Everyone likes that. One of the comments, or one of the quotes that I can use was something to the effect, "Isn't this wonderful?" And then you said, "I think so." Was there a purpose for you saying that kind of thing? And now there was another time and I'd have to go through my tapes, where you did the same sort of thing and I was wondering if there was a purpose, you know, that you were showing so much enthusiasm..

T: Yeah. It was just that. You know what I was trying to do was get them to look at what they take as obvious and to really consider the wonder in what was obvious to them. Because it is something that they all know and something.. but I don't think that people really stop to consider it. By showing enthusiasm and saying, "Hey this really is special." that maybe they will and a lot of them won't, but I think that a number of them will sort of stop and say, "Hey, yeah, I never thought of that! That really is unique. That really is important!"

I: Yeah. I was wondering if you were trying to do that or not.

T: Yeah. It was just to look at what was obvious and say it's really different.

I: You know you have made a conclusion. One day while were walking down the hallway, you said that you thought that the separate school students had a better..ah work attitude..well no they had a better attitude and they seemed to work better than the public school students. What observations lead you to that comment?

T: Well, I don't know if it was fair. Aah.. having taught in both schools it seemed that it you know, that the kids in the separate schools were..ah..it's a generalization..ah..more responsible. But I don't know, I'm sure that a lot of classrooms in the public schools are equally as good and a lot in the separate schools that aren't very good. You walk through a hallway at ____ (name of public high school) and there are garbage bags everywhere. I mean it's a horrendous place.

I: Well, I was wondering if that was something that you were getting at because you know, I just came from a school where the garbage was just awful.

T: I guess it is just respect for the school.

I: Now I know that the school was at absolutely its maximum capacity and the school shouldn't have as many kids as it does.

T: Either should we.

I: But the halls were awful. The kids mostly ate their lunches in the hall. And I was wondering if it was the garbage aspect that you were getting at.

T: I guess so. I think that's more it because kids in the classroom are pretty well kids in the classroom. I taught at ____ (name of public school) and the kids there were pretty good kids, I thought. But there was an attitude about the school, even an attitude about, I guess, maybe there was an attitude about the building itself that seemed to transfer into the whole process of education and it didn't seem that there was the respect. This school is not a particularly clean school and yet you don't see writing on lockers..

I: It's pretty good.

T: You don't see a lot of paper in the hall. You don't see sandwich bags around. (name of public school) is one of the better ones but you see lots of writing in the washrooms, you see lots of writing on the lockers.

I: And yet it's built so badly. The building itself is just awful.

T: So is this one. I mean this is a horrible building. This building has all kinds of rooms where you can't turn lights on. You can't turn them off. The rooms are hot or they're cold. This is not a well built school. Physically, it's horrible. It's on par with the worst. I think of (name of separate school where Tom taught numerous years) where you could go down a hallway and never find a piece of paper and writing on lockers. And that was a tough school, it was supposedly the same rated group as at ____ (public school

Tom taught at). It was a different attitude.

I: It was a different attitude. I wanted to explore a little bit about marking with you. When you mark labs, how do you mark them? Do you write comments on the labs or do you just do checks? or how do you do it?

T: Mostly just checks. Unless it is a real major misconception and there are some labs that I'll take up and some that I won't and the reason being, I guess, if I feel there is some value in taking it up and going through the questions, I will. A lot of times I find out that I hand back the lab and if I take it up or not really doesn't make a whole lot of difference because they will gain that information so it really varies on the type of assignment.

I: And you mostly mark the observations and questions that are within the lab?

T: Yeah. That's it.

I: Do you ever personally discuss a particular lab with a particular student that perhaps he has done badly or really well?

T: Yeah. In fact I'll put these kind of comments on. And I'll sit down with some and tell them.

I: What kind of guidelines do you follow in the return of material? Now I've noticed basically three kinds of things that you hand back, there's the labs, there's bonus questions, and there's the exams. There's written and multiple choice parts. Maybe I'm missing some things that you have as well. What sort of a guideline do you follow in trying to get the stuff back?

T: As fast as I can because the longer I take the harder it is..I have one set of labs right here that I have had for a long time and it's embarrassing because I've wanted to get them back but I've done another set that they have got back before I've got these ones back.

I: What do you try to follow in terms of exams? Do you try to get them back the second day?

T: Yeah.

I: And how about labs? During the course of the unit or second day?

T: Nah. Sometimes it will take a week to get them back.

I: So it might be into the next unit.

T: And quite often it is.

I: It is because you have them hand them in the day that they write the exam.

T: The day that they write the exam. What the lab does is..what I think it does for them

is that it provides some focus on the things that they were doing. Aah..I'll discuss the lab to a point with them but I think it is their responsibility to..you know..sort of ferret out some of the answers without me taking up the lab. I know that they do that in chemistry and I used to do that in chemistry but chem labs are really quite different. Biology labs are essentially thinking labs and if the effort is put in you are going to get out of it what you put into it. And if they really wanted to know what the answers are they will come and find me. But a lot of times I just don't take them up after the point. Sometimes I do and I can think of one on mitosis/meiosis that I took up because they were all kinda messed up on it. But other than that to take up a lab on the veins..heck they know what the veins do.

I: In terms of your exams, do you make up a new exam for each unit? Or do you have an exam that you use for each semester?

T: I do both.

I: Depends on the unit.

T: Yeah. Depends on the unit.

I: Do you collect your questions back again?

T: Yeah, but I also recognize that some of them slip out. And I make them available to kids too. So because of that I have to be a little bit cautious about which ones I am using. But I have a pretty huge exam bank so it's not a problem.

I: And what about the written parts? Those are new each time because they kept those didn't they?

T: Those are new each time.

I: You indicated that you dropped a student's lowest mark. Do you do that each reporting period..

T: I do that for the first 3.

I: So that it is a total out of 3 or 4 marks that they lose..

T: It would be a total of 3 maximum. And yeah there's..

I: Why do you do that?

T: I guess to alleviate some of the frustration. The kids are so exam conscious right now and everybody can have a bad day is what I tell them. So if you have one bad day you're not sunk. And I think that it removes that frustration. The amazing thing is that kids don't say, "Aah I don't have to study for this next one because I've got it made. I got three or four good marks." That has never happened. Because they always want to drop that lowest one even if it's 86. They want to have their lowest mark be 86 and not 57.

Buzzer interruption.

I: I noticed that you took time to actually discuss the report marks with each of the kids. Why did you do that?

T: Uuh so that they know what their marks were. There has got to be some (interruption by PA calling out a list of student names) and at the same time I think that they have a right to know where their mark came from. I have them keep their own records of how they are doing as well so I guess it's..there are no secrets. This is what you are getting and this is why you are getting it. In 13 years of teaching I have never had an appeal. So it works. And it's a matter of me being honest with them. I know a lot of teachers play games with kids because the average looks too good so they want to lower their marks. Lose a lot of credibility.

I: That was one of the things that I noticed with you is just your honesty. I mean it was your honesty when you were talking with (name of student). It was just an openness--here's one of the things that happens. It was sort of a humanness that was coming through. One last question and this is sort of specific about (name of student) and your IOP student in genetics in the Bio 20. How did they do on that genetics exam?

T: They got murdered.

I: They both got murdered.

T: Actually there were quite a few kids that got murdered. There were four or five that didn't do well.

I: And what were their comments? You know that they must have gotten a horrible mark on their file.

T: Yeah. 17% one of them.

I: Oh no.

T: But they knew it was coming and for two of them it's a repeat course so it is not a surprise. But it is still tough to take.

I: Do you think there will be any improvement in them?

T: No.

I: I noticed that today for example one of them had their homework done and the other one didn't.

T: Yeah.

I: Do they ever drop the course?

T: Yeah eventually. I think..I am surprized that they haven't already. In fact when I

handed out the marks I suggested to one of them that she rethink it.

I: Does the school have a policy about dropping courses?

T: No. Not as such. I mean you have to look at the individual situation rather than policy.

END OF INTERVIEW II

APPENDIX C-4

INTERVIEW THREE WITH TOM, NOVEMBER 16, 1987

I: Yeah, that's really a problem in terms of what am I going to do. I know an awful lot about you and my other teacher in terms of your professional life and what am I going to do with it. That question just keeps re-occurring. I suppose it's the same thing that you had with the student attitude thing.

T: Yeah, because there are teachers that would never even attempt it.

I: Researchers that would never attempt it.

T: They are fundamentally opposed to it let alone be worried about it not working. They are just opposed. They don't think that kids should be discussing science. They think that they should learn science. That's a scary sort...

I: Well it's that sort of tabula rasa idea. Their mind is blank and let's fill it up with some science type of thing. And yet that is not really true because there are all kinds of ideas that they have about science.

T: Interestingly enough one of the people that was probably one of the strongest opponent to that type of thinking was (name of teacher) about four years ago.

I: Really?!

T: Yeah. And of course we became good friends over that period of time and he really changed his attitude or at least he did in his discussions with me. He came from..it's a pooling of ignorance I guess..No maybe it isn't..right to the other extreme where he..he has actually said on a number of occasions that it is central to development of a good science program. So it is really interesting. ...

I: You're not feeling well today.

T: Well Yeah. Actually..

I: You sound just like I sounded a while back.

T: I am not going to talk too much more.

I: Well let's get on to some of the things that I wanted to do. In your Bio 30 - no Bio 20, sorry - you have already got three different groups of students - you've got your cloners, you've got your debators, and then you have another big group that hasn't chosen anything. You seem quite comfortable with that. What I was wondering was how that phrase "control of students", what does it mean to you and how do you maintain control?

T: Good question! There is a group of debators may indeed be some of the group that's

doing the cloning. So it is not even 3 distinct groups. They will all have to do one thing so there is no question and sort of the debate is separate from the project type of work so indeed I expect that some of them are doing the cloning work to partake in the debate. Those that don't of course do the paper so they all have to do some work. Those that the reason that I am starting the cloning right now of course is because it takes more time and I this weekend came up with a third thing that I want to do in the genetic engineering that is even more exciting than the cloning but you know, I guess, it's keeping track of where you want them and I know that the other groups can start in January and simply be able to accomplish everything in January. This cloning group will be doing more reading and researching about cloning. That's what January will be for them. It will be just reading for the most part although I've got another thing that I am going to bring in for them which is pretty exciting so really that is what I am looking at. It's really a coordination of facilities, and students, and timing and I don't know really if there is control..there certainly is not the control that you would have in a classroom lecture situation where they are all focussed upon you. There is control in the fact that the focus is upon learning. Or it should be. The opportunity is there for it to be on learning.

I: In observing you I get a strong sense that you are definitely the authority in the classroom. Like I mean you're bossman type of thing. How do you maintain that authority and how do you enhance it?

T: How do I maintain it? In different classes really do different things. I am more formal many times with the 20s than I am with the 30s. With the 30s there really isn't..it's understood as they're in there. A 10 class I tend to be more directive, very much structured. I don't provide them with a lot of opportunities to screw up early in the year. I mean it's certain labs that are structured labs and we don't do a lot of self-design things and I guess that accounts for some of it. If there is anything it is tailoring your lesson to the maturity of the student. You know, taking into account interests and other things, motivation. Of course you don't want to be so structured that it's day to day lectures which in 10 it isn't. Actually in 10 I do the greatest number of labs but they are very structured labs so it has never been a conscious thing to sit down and analyze it. But I guess the activities to an extent ensure control. The other thing is that kids just generally don't push if they are doing something that is reasonable like they have no reason to be disruptive. And I find that they discipline each other just by peer pressure and when most of them are on your side they're going to have to take a chance to oppose you and characteristically they don't. Although you will run into some but they are usually ostracized by their own class members if they try to push it.

I: How in your view is authority and control different? Or is it?

T: Well, I mean it should be different because if you are looking at authority that's generally associated with a figure and a position. Control is a little more subtle I would think. It's probably the observer who would define it differently rather than me because in many cases they interchange but there are certainly some situations where somebody can be an authority and certainly not have any control which is a possibility. You can exert control without being an authority. There were some students that will become the focal point if you like in a laboratory activity because of their expertise, their interests, their reading and they will essentially become the leader of a lab group and they will not have any special authority. Certainly within schools there are all kinds of

examples. The principal may be the authority person but the control person may well be somebody else. Independent of title.

I: You are all excited about something new that you were going to try in genetics. Do you have a guide or what is it that drives you to choose..

T: No guide.

I: ..Certain materials that are really beyond the curriculum and they motivate you some how. What is it about them that allows you to choose them?

T: My own interest.

I: Your own interest.

T: Yeah. And every year there is always something that is new and it's exciting and I seek things out. I seek things that aren't in the biological supply companies although there are really some good things in some of the kits. Some of the kits are not practical because they are so expensive but I'm..I continually try to bring new things to motivate me probably and then if I get motivated it is easy to motivate the kids.

I: You spoke one day in Biology 30 that you were going to have a seminar day. What does that mean and what sort of activities do you have during seminar day? I'm not sure I think that was the day that I missed.

T: Yeah. Really it is just an opportunity for questioning, focussing on what was covered. That's it essentially. It's a day when I'll come in sometimes with a number of worksheets, hand them out without the intention of taking up the worksheets because they are responsible to ask me things that I have gone over that may not be as clear as they might. The onus is really on them. It's sometimes a day that we will review labs. It's a combination of things. It's generally to prepare for the exam but it's not a study day. There are usually different components and I usually try to throw in two or three components within the day. Quite often a review of a lab, some question sheets and sometimes some bonus application. Actually we were into one day that was more or less a seminar day and it was just a lot of application and discussion which was a chance to focus on the work that we were doing.

I: Oh, I remember that day. It was on blood, wasn't it?

T: Yeah.

I: And you had a awful lot of problems for them to work out on the board and they were really, you know, application, going beyond type of problems, and synthesizing all the material together.

T: That was sort of one type of seminar day. Sometimes they are not even aware that it's what I would call a seminar day. But it's no new material but it's let's apply, let's focus, let's sometimes review and bring together and synthesize and I do it especially when we get into the kidney because then what I attempt to do is bring in circulation and

relate..drawing them all together.

I: You know I sense a real struggle within yourself about that body fluids policy that came out. And I think that you are beginning to feel that there is going to be a pretty significant impact upon your Biology 30 course. I don't know about your 10 and 20. What are the main impacts of what you are feeling?

T: Well, what I am feeling is that I don't have anything in place to bring in as an alternative and my argument is really not with Alberta Ed in the curriculum branch because I'd have probably done the same thing that they did. The difficulty is not having a lead time to have something in place that is equally exciting. There are things out there that are equally exciting. You don't have to do the same traditional things but it requires imagination, creativity and I mentioned to you one day that I thought that science consultants if they were going to do something that would be..I mean it's not just up to publishers because publishers can't respond to changes that occur within six weeks. And writing teams cannot. I thought it was an opportunity for them to come in with something that's creative and exciting and to say don't do this but now do this. Even if they were to identify resources that had alternate activities. I know our lab book for example, has an alternate activity in that we use a simulated urine in the hormone section. There are certainly things that you can do now but it's not being done. It was just a policy and no follow-up. I imagine it reflects the economy but as a teacher it's difficult and it's difficult because I've had teachers phone me up and say now what are we going to do from other schools. And the teachers here in the school because there are three biology teachers. So they're saying now, "Now what are we going to do?"

I: That was my other question of you. How do you think this is going to affect Joe Blow, ordinary teacher out there.

T: It is. It's affecting them but people aren't really angry because I think they understand why the decision was made. But I think they are frustrated and they are saying, "Boy that's the best part of our course!" and..

I: Yeah. All of a sudden I think there is a vacuum there.

T: Yeah.

I: And there's..teachers haven't scrounged..in order to fill that vacuum.

T: And I certainly think that we need a new focus in curriculum because of that. And I think that there are some really exciting things that are out there that as I am finding are probably more exciting than what we are doing but it's going to need some changes to the curriculum.

I: Working and adaptation..

T: Yeah. And it's an evolving process. But I have this fear that what's going to happen to biology if we are not careful is what happened to Chemistry 20 when they removed all the organic chemistry. Now we have a course that is full of sticking models together and that does not turn kids on at all. And then they don't do any lab work until they do

solutions. And it's a horrible course to teach. It's antiseptic. We tell them about things. We don't do anything.

I: You know you have been teaching for a good number of years. You obviously enjoy what you are doing. Aah, where do you get your "strokes" - quotation marks - from the process of teaching?

T: Mostly kids. As you're aware, there is very little in writing. In fact, there is more criticism than there is compliments. Money doesn't pay you for..certainly doesn't warrant the..

I: Time, investment, stresses..

T: The stresses is the main thing. I guess that is mostly it. The rest doesn't..there is not enough pay-off from the other stuff that I do.

I: Well is there..do you get pleasure in having your lab manual to be accepted? or your issues book? those things as well?

T: Sure. Well it's accepted in Newfoundland. Laughs I can't even use it here.

I: Really?

T: No. Aah..my own board will not bring it in. The science consultant is waiting for Alberta Ed to make a move on it. So..I'm..We're using it but we are duplicating it and doing it illegally.

I: Right. With your, as an author permission!

T: Yah, nobody is going to sue me.

I Exactly.

T: But they could technically.

I: You know, as your job as a coordinator, teachers and students, I gathered, come to you, again sort of as an authority. Does that make you feel good?

T: Not really because most of it is..are problems. Like they are coming to me in most cases with problems I can't solve. And yet, you've got to make a move to solve at least as much of the problem as you can. But most of the problems truly are problems that are well beyond my control and my regulation. I can move toward solutions but obviously recognizing that there are no total solutions. A lot of the things that happen are because of teacher exhaustion so you give some teacher some breaks. Aah..you get them out of the school for a day or two for some inservicing and things like this. Aah..you know those are a lot of the things that I see. Some of the curriculum things that are done, not necessarily from the outside but sometimes from within, confine. It's great to have structure but sometimes the structure becomes confining so it's a matter of rating situations. That we can still have some control over but it's still difficult.

I: You know, sometimes teachers are viewed as gatekeepers. They determine whether Johnny goes on and whether Sammy doesn't and that kind of thing. How do you feel about this function? Or do you think that teachers are gatekeepers?

T: The public certainly does. And to an extent I think more so we are being forced into that situation.

I: Do you want to explain that a little bit?

T: Well one of the things that parents have certain expectations of their children. And they're very unlikely to criticize a student that's been working that is not achieving and I think that is positive with the parent. Then the criticism can only fall in one other direction. Certainly the people that set curriculum, the people that set evaluation standards are not accessible to those parents so it becomes the teacher who's accessible to those parents and we just had parent-teacher interviews and we had a lot of parents who were really upset because their students were achieving 80 and not 90. They didn't understand why when they are working as hard as they are and they are good kids. And the parents..it's a legitimate question. So it becomes..it's becoming a real true focus..much more than it ever has. Especially with that 70% average..

I: At the university..

T: So it's.. The teachers are under a lot more stress now because of it. And the parents are kinda..we went through almost two years of school here without a single appeal and that was at the end of the year. We had 9 appeals of Grade 12 marks on the first report card. We have never ever had an appeal..we had one appeal on our first three years and by two kids.

I: And you've had nine just after these last report cards?

T: We have had nine after this first report card. And that tells me something.

I: Boy, I'll say. Well, that brings me into the next set of questions. How do you view diploma exams? Do you think they are necessary? And how do you view some of the uses that are made of diploma exams?

T: Well I think the diploma exams are not really useful. I don't think that they are bad or that they are poorly organized or constructed or any of those things. My criticism is not with those people. I see diploma exams put in place for post-secondary institutions. They have effectively become a screening device. And post-secondary institutions are very irresponsible in the manner in which they sell our students. A good example is a person... (could not decipher) from Calgary that may have Math 31 for fine arts which is irresponsible, I mean, they are looking for students that are artistically creative and demanding a calculus course which is insane but it is an effective way of removing a number of the population. Why should a student who is going into the faculty of commerce have to do a biology exam? I mean either the university is saying that they do not trust the teacher's assessment which is continuing to be proven within the range of the diploma anyway in most cases. Why are we doing this exam. I have no idea.

We're...you know if you wanted to take the course, fine. If there is a component in commerce that requires biology why don't they set those in the way of an entrance exam and if they are looking at specific skills that a student should have the onus should be upon them. They determine what their faculty wants anyway. Why don't they go one step further and set an entrance exam and not a curriculum based entrance exam. That's the other thing that is unfair. Either a kid has math skills or they don't. Why do we test them on one year and put the onus on that particular teacher for one year. It's ludicrous. If we look at whole schools - high schools - most of the teachers in high school are not affected by diploma exams and they do face the survey that teacher populations here ... (could not decipher) do a good thing. And they ask typing teachers and accounting teachers and they say, "Yah, great. Make the students more serious." But they are not the people that are affected. So what's happened in the last number of years is we have selected a group of teachers that teach grade 3 and grade 6 and grade 9 and grade 12 and we have put them under a microscope. And if you teach grade 4 you escape and if you teach grade 10 and 11 you escape you teach. And characteristically what is really sad about that is that if you have a weak teacher in the school you make darn sure that they do not teach diploma subjects so they are further rewarded for incompetence because they are not put under a microscope. Those that do teach it are generally your experienced hard-working teachers who are given a greater workload and then criticized. And it's unbelievably unfair. The ramifications have gone far beyond what the intention was. And again I don't necessarily blame Alberta Education and I think Alberta Education, at least when they took on the project, in my opinion, have attempted to produce a quality exam that does reflect the total curriculum in as much as it can be tested recognizing and they have stated that there are components that you can't test. So it is not with the individuals there or the exam construction or any of the obvious things that people tend to criticize. Those things are really pretty good. What I criticize are the implications for teaching staff, the implications for students that extend beyond the boundaries of the exam and I think the exam has outlived itself. It may have re-focused people in Alberta and for that it was probably good because it did provide a focus on curriculum. Again though only in selected areas for selected years for the elementary. And in the high school only for some teachers. There are other teachers that are teaching Chem 10, as an example who have never read the curriculum guide. They'll pick up Alchem and they will teach Alchem page one to the end of the book and that's their curriculum.

I: You also spoke of the school being very successful in terms of diploma exams. Why do you think the school is so successful in getting high marks?

T: Good teaching staff. Very positive teaching staff. We are the youngest high school teaching staff without question in Edmonton Catholic. Now young is not always better but it's...I think that we have a combination of the young people and the older people that are here are very enthusiastic, very positive. Generally I think it's an excellent teaching staff which makes a difference. Kids for the most part like going to school here. Aah...I would say that's the biggest factor. Lots of support from administration. We have also been involved in field testing, test development, aah...we have had inservices. Right in the first year we had (name of education official) and the entire evaluation branch out here. Everybody got to come and we had about nine of them here. The second year we had (name of education official) here talking about the Secondary Ed Review so it's an informed staff. Lots of resources in the field test. They are not as valuable as they once

were though, but the teachers know the curriculum and they know what is expected and they know what is going to be asked so that helps prepare the students. It's a lot of things.

I: Right. Is getting a high average on a diploma exam important to you?

T: No. I have had classes that have had really high averages and last year I had a class that I was really disappointed in because.. not because their marks were low; they were actually higher first semester than they were second but the kids were capable of so much more and I found myself really disappointed first semester. The class average was 70 and the second semester it was 69 point something or other and it was a couple of percent lower - it was 69 and the other was 72 or something like that - I was much more pleased with the second semester than the first so I guess not.

I: If you were to aah..actually try to pinpoint the absolute essential ingredient or maybe couple of ingredients that makes the school what it is, what would you say they are?

T: High energy. Caring. Probably the student.

I: You know this question was quite pointed to me because I thought..I was actually making an interpretation here and I wanted to see if you substantiated it. I thought I detected a great sense of caring for everybody I've talked to; in the staffroom..those little meetings at noon have been invaluable to me. I also detected it among the students what they were saying about the staff. That it was caring and I wanted to see if that was what you thought as well.

T: Yeah. I think so.

I: What about its newness? How do you think that impacts on what it is doing? Cause it's three years old, right?

T: Four. This is our fourth year. Actually we are going into our fourth. Aah..Well things happen. You.. Everybody comes in and they are positive. Your first couple of months are a honeymoon. Then you start discovering which light switches don't work. Some of the equipment you wish was there wasn't. Aah..you know some of the lines of authority may not be clearly established. This is not..this is a unique school because the principal does not place herself in an authority position. She is not the one that answers all questions and things like that. She delegates a tremendous amount of authority and..

I: She is a facilitator then..

T: Yeah. And that in itself is unique. The difficulty in that is that she has delegated a tremendous amount of authority to me and now I have 28 people and still have to teach half a day. Other than student problems with attendance they will see a grade- one of the vice-principals that is in charge of that particular grade - everything else they come to me and that is a lot of things to remember and keep going and there's pros and cons.

I: In other words, this whole idea of the Academic Coordinator and the other coordinators within the school, that, also impacts the way that it is..

T: That's right.

I: ..Very strongly. Have you got more time?

T: I am going to have to run down and see (the principal) for about two minutes and I'll be right back.

I: Sure. Absolutely.

Pause and tape re-started in the middle of the conversation..

T: I just have a teacher covering his afternoon class so we can give him a half day off. Sort of in lieu of..anybody that marks all weekend needs some time to gather his thoughts. So we try to facilitate that within the school and I was just letting (principal) know..

I: That was what you had done..

T: That's what I had done. Cause she is the principal technically and that is something that principals always do but she said, "Well just go ahead and be discrete." If he shows up in the mall or something, he's in trouble. Laughs. Naw, he'll stay in the school and he'll do his marking in here but it's a chance to step away and just go, "I've got a half day off!" So that is one of the things that we do here reasonably often. Is that we'll have one group of teachers cover for another. We had all our science teachers at ___ at that chemistry presentation except for me. Laughs. And we had their classes covered by other teachers and then we'll have an English half day inservice which we had on students preparing those little hard cover books with their own writings and we had the science teachers cover their classes. I'll have Social Studies out on a half a day sort of a curriculum workshop for evaluation and other things and Math will cover. Then math goes out and somebody else will cover with the administration too. The administration here is really good for that. Aah.. because they pitch in and take classes which in itself is unique. So most semesters any given teacher can be out at least once on something that is special. Maybe only half a day but it's you know, it's up and above what is required.

I: You know, that makes a sort of special feeling of ownership doesn't it?

T: Yeah. It also is neat because the teachers that are in English say thank you to the Science teachers. "Thanks for covering my.."

I: A line of communication that is normally nonexistent.

T: Yeah. Well it is in this school because we have meetings together too. And we got a meeting which I wanted to call for Tuesday is right now. My voice isn't..I wonder how valuable it's going to be. I think what I'll do..no maybe I better do it Tuesday but just getting people in because they were very concerned about parent comments. And so there is lack of communication between the two. You know you talk about why I don't believe in diplomas..one other aspect is only 8% of the kids that write a diploma exam get an honors mark in English, 42% got an honors mark in mathematics in January of this last year. So parents are asking questions like why is my son an 80 in every subject everywhere

except for English. This puts the English teachers under tremendous pressure. Because their marks are characteristically 10 - 15% lower. And it's not their doing. It's in line with provincial evaluation standards which make no sense. How could 42% of kids who take Math 30 get an honors mark and 8% in English (interruption by PA) and then if you look at those that get plus 90% then it's 10% in mathematics; it's 2% in English. So 2 out of a 100 kids..well that's insane. So sure the marks..there is no relation. So parents want to know what the devil is the matter with the English teachers. Why aren't they giving out good marks?

I: Yeah..Under a microscope.

T: So math and science teachers (Much activity in hallway and in room where interview is taking place including PA announcements that drown out the recording completely. Tom and I discuss whether we should continue..

I: Well maybe I should attack some of those that are somewhat different. What do you think identifies yourself as a biology teacher within the school?

T: Probably nothing because I have taught math and chemistry and biology.

I: So it would be several different things?

T: I don't think the students walk through the hall and a lot of them are surprised when I teach biology.

I: But you teach chemistry - that kind of an attitude?

T: That's right. And those that were in my math class were really shocked to find out that I was teaching biology the first year. It's..they don't really know.

I: That's interesting because I hadn't realized myself. I knew that you taught chemistry but..aah..OK. Here's one that is sort of general. If you were in charge of the curriculum what changes would you make to the science curriculum?

T: Actually a lot of the changes that they are making. I think it's the first step and it's the right step. Certainly the technology emphasis. I think one of the things that they are going to have to grapple with is that teachers are gonna have to be asked to do some core labs and maybe it's not a core lab but maybe they will have to identify 3 or 4 labs and you must do 1 of these labs to teach that concept. Because what I see happening in biology but not within this school but I know in a lot of schools because teachers have come right out and said, "Hey, I'm not doing any more because I don't have time." or whatever is where we are really losing the whole intent of the curriculum. So I think that people are going to have to..there's going to have to be something addressed to lab work. Aah.. and I hate to be doing one specific lab as core so I would think that you have to choose 5 or 6 from these resources but one of those has to be accomplished for this section and one of these for another section or show something equivalent. And I think that teachers are going to have to become accountable for that. Other than that what I would like to see..I would like to see a stronger focus on application for science which is the science-societal issues certainly to look at focussing on teaching strategies. My theme is that in a lot of

classrooms teachers do the same thing that their teachers did. They don't learn to try new techniques, new approaches, new strategies. I think some of those could be done by video inservicing, video tapes, all sorts of potentials there, Cheryle, and that would really be my focus. You know, I think that science at elementary is very poorly done and I think I know why. Is to a large extent the support materials are not adequate for people that are non-science majors so they really have to go to some really good teacher edition science resource material and things like that..that give lots of direction and things that are not overly time-consuming because nobody has the time to read a binder of 600 pages so you got to do some stuff more in a kinda of creative mode. Video-taping a teacher's edition makes a lot of sense.

I: Sure and the teacher could simply watch it..

T: And then they know the technique.

I: Sure they have seen it in operation rather than the reading about it. I don't know cause to me..I find that I can work best if I can actually do it. And I don't find anything below my dignity so to speak. If I can actually get down and grub around and do it, I can then apply it in my teaching and at other times I have trouble. Aah..OK I am already sensing a fair amount of opposition to the general science program and I am assuming that you are completely in agreement with it. Correct me if I am wrong.

T: Well for the most part. Yeah.

I: How would you go about alleviating.. I guess, the kinds of things that you have just mentioned. My question is how do you go about alleviating some of this opposition to it cause teachers really have not even seen it and they are saying, "Oh geez, this is awful!"

T: Well I think that I think we can appreciate that because the outline that Alberta Education has given would appear traditional and it's not. I mean their intent is not..But you can't get that from an outline and I think it's going to and maybe it's ego but I think a lot of it is that the resource will do some of that. Aah..but it's beyond that..it's we have to look at (Interruption by PA) ????? and if the teacher uses a didactic approach instead of a laboratory approach they are not going to accomplish it. There has got to be more. It is a self-design lab. How do you use a self-design lab? When do you introduce it? Boy you can use a self-design lab and have it bomb. Because you used a lot of structure..

I: Because you introduced it at the wrong time..

T: Yeah it was timing and these are things that really have to be worked out.

I: So in other words it's the methodology that has to be worked on.

T: Yeah. That's my opinion.

I: You know being here with you has just been an absolutely wonderful experience for me. I have learned so much. And being a scrounger I'd say, "Geez, you know, I could really adapt that to my classroom!" I was wondering if my being here has done that to

you in any way. You know be positive/negative whatever.

7
T: Oh sure. I'm aware of the fact that you are here. Sometimes I'll even ask you a question in class. It's actually nice to have somebody else in the room. I tend to want to be interactive with another person and draw them into the conversation so..and I know that you are here to do research so if you weren't here to do research I'd be drawing you in a lot. And..

I: Actually I think that the students would like to draw me in too..

T: Sure they would. They're..well it's an open type or at least it's supposed to be an open type of an atmosphere so there's..or I guess my focus is that I'm not the only one that's a teacher and there are many..and that's why we do labs and they discuss labs and they talk to each other. I tell them when we do bonus questions, "Talk to each other for a bit."

I: You view your role as a facilitator like your administration? You've used their role in a lot of ways.

T: Sure to a large extent. I mean, there are a lot of things that I still do that are very traditional teaching.

I: Well we all do.

T: Traditional teaching works!

I: Well yeah but you also venture into grounds that are not exactly traditional. Or maybe traditional is the wrong word to use that not everybody does..the majority of people don't do. So you are out of that constricted mode. Well let's call that a day. I haven't gotten all of the things that I was going to ask you but that's OK. And I'll come back and be with you in Bio 20 and then you are gone Wednesday, Thursday, Friday.

APPENDIX C-5

CONCLUSION OF THIRD INTERVIEW WITH TOM, NOVEMBER 17, 1987

I: Well, I am really glad to see that it is going. (Discussing the cloning experiment)
One of them sorta has a whole film of orangy stuff. That's callous?

T: No. I thought it was. I think that is bacteria. And I don't know what type it is but just the fact that it is slimy and mucousy. I thought at first that it may have been cells that broke off and differentiated but they won't. You see they have to stick together.

I: As a lump?

T: Yeah. To do that they would have to be cancerous. Which is always a potential, I mean, well..depends on how we define cancer but as far as the plant can get cancer because there would be no adhesion to other cells and intercellular communication.

I: And that's why it would be..

T: But I am sure that it's bacteria now.

I: You're probably right. And one of them has a whole bunch of bluey type gunge on it and that's probably a mould.

T: I am thinking that it is a mould, yeah.

I: Well I suppose it could grow that quickly..but not likely.

T: I don't think so. I think it is a mould.

I: Well I hope it works for you.

T: Oh I think that it will. We can still take a lot of callouses off.

I: Sure. And just simply learning the technique.

T: Yup.

I: My first question had to do with the project. You are obviously doing a lot of extra work, you know, in terms of looking for resources, hiking over to Prairie Biological, talking to whoever over there, just simply thinking about the thing. What sort of rationalizations do you use to convince yourself that it is worth the time and effort?

T: The way that the kids were talking in there. They rushed over. I said to them that sometime between now and quarter after..a couple of minutes after..a minute after I said that they were all over talking about it. So it wasn't me pushing them, trying to stir the enthusiasm - it was there. And I think as it starts to grow now I am just going to leave

the door open and you know, they are going to go in there and they are going to look and I guess that's the rationalization.

I: You know there was a question from one of the kids that had asked, I think that it was (name of student), and she had asked something about whether you were going to guide them through the whole thing or whether you were going to let them go. Why do you think that particular question stemmed? What was she getting at?

T: Yeah, (name of student) comes from another high school and she has mentioned to me numerous times that they never did labs and she's a little baffled by the fact that Day 1 we do this and Day 2 we do this and 3 we do this. And she is trying to sorta find her way in this whole process. Whereas the labs that I have done in class have been highly structured but I think that she is excited about the potential to try things on her own. And she is not really sure whether or not she will be allowed that type of latitude and freedom. Although I have told them that they could, she's wanted the reinforcement of, I guess, you're really going to let us do this.

I: Well sometimes teachers will say one thing and they will do another. And maybe that was what she was alluding to.

T: Yeah. And that's quite possible. And there is a fair amount of guiding that I'll do at the beginning because we are going to start growing the callouses and making the seeds antiseptic. I wanted to do that today but again they have cut my class down for me. So it's one of those things that you just put off and with me gone it was probably just as well. So.

I: Well it will give these callouses a good shot at going and growing some more or dying or whatever they are going to do.

T: Well that's right and in the meantime what we'll do is grow our own callouses and catch up to that other stage that we're in.

I: How do field trips fit into your teaching?

T: Field trips are really tough to do. Aah..

I: Why?

T: You're looking at the fact that there are so many field trips already in the school.

I: In other?

T: Yeah in other areas. We had an assembly today which was an important thing on teen suicide but it's a matter of actually pulling the kids out and knowing full well that they are going to miss half. Some of them are weak in math. So I tend to run it differently. What I used to do is, matter of fact, I used to run a Saturday field trip and credit them with that time off class the last week of class in June which was a benefit to me and a benefit to them. Aah..it would be the week just before they wrote exams and we would finish off biology and I would say, "Well look we're supposed to put in 62.5 hours and we

put them in and we put in 6 hours on a Saturday so you have 6 hours off class." And that worked. What I tend to do now is that they do almost independent field trips and they do that as part of their project. Now winter is not the best time to really do the field trips but I have them do pond studies and pond-lake studies and some mixed woodland studies as part of the 20 project. Of course this is the spring project. We'll do some winter ecology right in the school yard. So yeah, we do it. We don't go to Ministik Hills, there are teachers, ____, is one that does. And he has been successful at it but the expense, the disruption to do it for every kid in the school is really tough.

I: Does the money come out of the science budget then? For busses and so on?

T: To a small extent but we are asking kids to pay and to supplement some of that. I think that it is pretty pricey when you go out to some of these places.

I: It's the bus...well yeah you're right because there is a fee that you have to pay just to use the place plus the busses which really take a big chunk.

T: And the other thing is, I mean, what they supply is good value but it's awfully expensive when I look around and I say, "Well for that same price, I could do something just as dramatic in my own school yard." And that's being creative. Is that you don't have to be in a natural environment. You can do some really creative enthusiastic things right out in the school yard. And snow ecology is a good example. You can do that anywhere.

I: I am almost tempted to try that one myself. Maybe with my university class and see how they feel about it. If I can get myself together maybe that might be a different project to expose them to. I noticed that you...I guess, I could say quite often, use student answers and use something that a student has said as a basis of what you do for the next five minutes. Sometimes you put it on the board. And you'll say, "I couldn't have said it better! I'm going to copy it down." So you copy it down and then you focus the rest of your teaching on what the student has said. Why do you do that?

T: Well it's I guess, it's a feeling that either the lecture comes from me or they're involved. A lot of times I'll say, "It's a great answer!" and I'll want to add things as I go. It's, you know, you can't put them down for feeling involved.

I: What's some indicators of successful teaching?

T: Student enthusiasm I would think is probably the best indicator.

I: In class, or about the course, or about the teacher?

T: All of them.

I: All of them.

T: It's not one thing that you look to and some students can be very enthusiastic and not express it. And that, sometimes, takes time as a teacher to recognize. I know when I first started to teach you would focus on the exuberant expressive student. Those that..

can think of some, that I taught, that would just explode with enthusiasm and what I didn't recognize is that some other ones that were much more withdrawn and reserved were equally enthusiastic. It was just that they had a different way of expressing it. And it sometimes came as a great revelation when I would talk to them after they had left the course to find out that they had enjoyed it cause I sort of interpreted that they were not very active within the course and they could have taken it or left it. Some of them enjoyed it more than those that expressed the enthusiasm.

I: Anything else?

T: That's about it.

I: In your role as a teacher, what accomplishments are you most proud of?

T: I would think good teaching or at least I..I hate saying that because I have never met anybody that said that they were a bad teacher, and I've met some horrendous teachers! But I think for..and I recognize that I certainly haven't reached every student by any means, but I'm pleased with the fact that I can meet students years later and they remember me, they remember the classes, those types of things. I'm proud of writing. It's, you know, something not everybody does, so..and I think, that I would like to think some of the things have been innovative. There are some very good things in the market but they are really traditional and I don't think that my lab book was traditional. I think that it has some unique features. There are lots of traditional things in it but there is something new. The issues book, was something that I didn't initiate certainly, but I think I added into it the interactive debate, environmental modeling labs, those type of things, you know, I think that's been unique. It's added another dimension to the science course - to teaching strategy in science so..

I: That's what I was going to say that new..

T: That's what I am pleased with.

I: ..Strategies that perhaps, you know have always been there but not stressed very much or not highlighted not focussed.

T: I think that they have. In the fact that I go to some of the conventions that I have done presentations at and teachers say, "Well I've been doing that." and I say, "Yeah, I'm not doing anything that's terribly unique. I am focussing upon it maybe and giving it a little more emphasis than some." But I know it occurs in a lot of classrooms.

I: What do you draw on to deal with any problems that develop within your teaching? With students, perhaps. With parents? What sorts of things do you draw on?

T: Well. Self-confidence. Laughs You have to. I found this last week, after parent-teacher interviews is that a lot of teachers began questioning what they were doing and I guess it's confidence in your approach, not to the fact that you don't recognize if things don't go well, but I guess, that's probably the.. you've got to be committed and you've got to have thought through the process but then you can't question everything that you do and it's important to be reflective but if you are too questioning you become indecisive

and that's one of the..

I: The whole process starts to break down.

T: It breaks down. And certainly if you read some of the grad papers that we have to read, that we all read, is that they demand self-evaluation continuously. Well you've got to do that in a reflective capacity but you can't become self-critical to the point that you are afraid to do anything to try something new. And I am afraid that is what it instills in some cases. There is a fine boundary.

I: Oh yeah. You better believe it. Because it is just like you say: You start questioning too much and pretty soon, my gosh, I am going to quit teaching.

T: Well, that's it. You have a student that falls asleep and you think, "Oh my god, my lesson was awful." And then you find out that he worked all night.

I: He worked all night! Oh exactly. This other question goes along with what I asked you before. If you were the director of curriculum, I'd asked you before, what sort of directions would you take. This time I'm going to do it the other way, if you were the director of evaluation what changes would you make?

T: Well the one thing that I would look at in science, certainly, is a greater emphasis on lab skill, lab component. I would go the route that they are going which is the larger, open-ended. I would spend more time inservicing markers before they marked. I think we spend a whole day for headmarkers and they now have a feeling for what's expected and then they are supposed to translate that in an hour and a half orientation session which is just not realistic. So to bring in new people which they are doing is good but I think they need, you know, a full day for the headmarkers and a full day for the other markers before anybody touches a paper and that is severely flawed. If I had some tremendous new way, what I would like to do is put the onus on post-secondary institutions to come up and test those skills that their students require. I.., I said before I don't think that it is realistic that somebody going into commerce is asked about physiology. They..they..I think it is important to take the program and that they have the education but why not use teacher assessments in that particular case? I think that we are missing the boat when so much of the evaluation is structured to eliminate people from post-secondary institutions.

I: When you say..You said something to the effect that you'd like to go or you agreed with the way that they were going with more open-ended. You can take that two ways..what do you mean by that?

T: Aah..The types of questions that we worked on this summer..

I: More of..

T: Yeah. In other words, if you answered this, this must be true. But if you answered this, this could be true providing that you have the following rational. Those are the types of things that, if it really is an interpretive science, which it is, the conclusion has to stem from your initial hypothesis and that we have neglected. We really have.

We..we're still looking for a right answer and a right answer is not always what science is about. Science is a hypothesis and how would you test for your hypothesis or how would you conclude or refute that your..

I: Could you see evaluation going in the direction of actually giving the kids equipment and saying design an experiment to test this?

T: It should within the classroom but provincially there are too many constraints. Teachers should be doing that to one extent or another. The difficulty comes in how many times you have to do this. I can come up with one or two models that work very nicely but then it gets really difficult and it becomes a remake of the same thing within different concepts if you like. But the construct of the experiment is the same and that is the unfortunate thing is you begin to use the same methodologies and now you are testing something very different. It is an application rather than a true bit of creativity. If we are really interested in that type of evaluation we should let students talk to each other too when they are doing it. And the idea that scientists work isolated in an insular fashion is ludicrous. So it's not viable for a provincial evaluation.

I: What about the idea of using essays?

T: Aah..They are having so many difficulties using the essay say in social studies, in my opinion, that when we look at the essay I'm afraid that they would mark 10 content points and omit some of the other things, some of the other components. Depends on what they bring into the essay of course. But it is a possibility. We're not ready for it; our markers are not ready for it; our science teachers are not ready for that drastic..

I: So you are basically quite happy with the format. How about the 80-20 split?

T: Well..that's..Don't get the idea that I am happy with it. But it's a compromise..

I: No, but you're comfortable.

T: It's a compromise based on where we are with science education right now and I think it reflects sort of a middle ground slightly leaning toward the conservative element. But it seems to be the case for most - textbooks, evaluation, curriculums..Aah so I am not really surprized. Yeah, it's a good compromise. The product is not a poor product. The process of developing the product is..is.. I think considering financial restraints, is still pretty responsible so I tend not to be as critical as some people.

I: Aah..going to something that you and I had talked about previously. And we had just mentioned it when we were talking about the opposition to the proposed general science program. A couple of things here. Why do you think there is this opposition and secondly the general science program is going ahead so how, if you were in a position of authority, and actually you are, how would you go about alleviating this opposition?

T: I think one of the things you have to do is get something out in the field, that, for example, is electronics that you have enough support material that a biology teacher can accomplish. It's fear that and they're responsible people saying, "Look, my physics is rusty, my chemistry is rusty, I'm a biologist." And I think that's the fear that has to be

broken down. It's not people that are bitchin and complaining it's people that are afraid that they cannot deliver a quality program. And I think sometimes, that's misinterpreted by administration either by Alberta Education or within school systems and they say just go ahead and do it. Well there are some people that are very high, very good quality biology teachers and don't want to have their quality of biology instruction compromised by the fact that they're doing something that they don't have as much background or as much training in and they're aware of the fact that hey look my bio class is exciting and good because I can bring in these interesting aspects and they're very much afraid that they won't be able to in areas that don't reflect the same academic background. I think that if they taught the courses in the same way that would certainly be a justified concern. I think what we have to break down is the fact that there are certainly some interesting work that kids can do where you don't have to be the focal point. I mean, you don't have to be the person that is injecting the enthusiasm, the interest and all those things. That..that sometimes you just let them go.

I: You become the facilitator.

T: Yeah and that's a different form of teaching. And I think that's really where that stems from and I think to bring that across in (name of education official)'s position or (name of second education official)'s is really difficult because there aren't the resources there. Like they can't pick something up and say, "Here is a resource that allows you to be a facilitator." Because it doesn't. You still have to be the director and the organizer and whatever else and I guess that's the challenge for the resource developers. It's interesting because you can't go to the other extreme immediately. Like there's got to be that balance because we are not going to change teaching styles drastically. So some of the things that I would like to see and some of the things that I would like to see left out, you know, I've got to bridge some ground here too. I can't always do what I want to do because it won't be successful so that's the other aspect, I guess.

I: Because you just can't jump from Point A to Point D. You have to follow somehow through the little sets.

T: Otherwise we'll get the swinging pendulum cause now we are all going this way and three years later it fails because people are not ready for drastic changes in their teaching styles.

I: I imagine..you know I have a feeling it's very difficult to change from a completely teacher-centred person, teacher-centred in your teaching, to all of a sudden learning from the students and having the students as the focal point and the teacher sits back. You know I think that would be a terribly hard step to make.

T: I think that it will be devastating for some people. And I don't think that it is going to be very successful for some people either. I think they are going to have a tough time but I think that's why you are going to have to find some conservative ground in that a lot of it's going to be teacher-directed still but you do provide student activities that allow them to discuss, that allow them to interact and recognizing that teachers may not use all of them but they'll start using some and gradually move in that direction, I hope.

I: You've answered my next question because I was sort of thinking how would you go about implementing it. And your points about being gradual and sort of introducing it slowly..

T: And give them a variety of activities because some of them may feel comfortable with the debate and some of them may feel more comfortable with a brain-storming session or responding to a strong opinion or something like that. So that's..

I: And eventually some will feel comfortable with modelling..

T: Yup.

I: And demonstrating and that kind of thing. Maybe somehow, and I guess this is where my research comes in, somehow having activities that fit in with what the teacher believes in deep down. You know the underlying beliefs and values and if you can do that you have essentially converted that teacher.

T: Well, I don't think that you convert people..

I: Well you haven't converted them because it fits..

T: I know what you are saying..But you've opened..

I: ..With what they believe in deep down..So they will change ..Sort of on the surface they'll change.. so they'll seem to change but they really didn't change because that is what they believed in to start with.

T: Yeah. That's right. I think you open some possibilities and let them expand their possibilities maybe at best.

I: OK. Thanks a lot, Tom.

END OF INTERVIEW III